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Vol. VI

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, ~~1942~~ 1945

No. ~~721~~ /

THE NORTH AMERICAN COMPANY, PETITIONER,

vs.

SECURITIES AND EXCHANGE COMMISSION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

PETITION FOR CERTIORARI FILED FEBRUARY 10, 1943.

CERTIORARI GRANTED MARCH 1, 1943.

United States Circuit Court of Appeals

FOR THE SECOND CIRCUIT

October Term, No. —

THE NORTH AMERICAN COMPANY,
Petitioner,

v.

SECURITIES AND EXCHANGE COMMISSION,
Respondent.

TRANSCRIPT OF RECORD

TESTIMONY

Volume VI

(Pages 2044 to 2499)

ON PETITIONS FOR REVIEW OF ORDERS OF SECURITIES AND EXCHANGE COMMISSION

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6130 BEFORE THE

Securities and Exchange Commission

Docket No. 59-10

IN THE MATTER

of

THE NORTH AMERICAN COMPANY, *et al.*

6131

Hearing Room 622,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Wednesday, October 23, 1940.

Met, pursuant to adjournment, at 10 o'clock a.m.

6132 Before: W. W. SWIFT, *Trial Examiner.*

Appearances:

S. PEARCE BROWNING, JR., and CHARLES S. HAMILTON, JR., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for the Respondents.

RALPH C. BINFORD and ARTHUR J. BUSWELL, Attorneys for the Securities and Exchange Commission.

PROCEEDINGS.

The Examiner: The hearing will come to order.

Mr. Hamilton: Mr. Stokes, will you resume the stand?

Whereupon, STANLEY STOKES resumed the stand and testified further as follows:

Direct Examination by Mr. Hamilton (Continued): 6134

Q. Yesterday, Mr. Stokes, you described the main transmission system of the Union Electric Group. Will you now describe the sub-transmission system and begin, if you will, with a statement of what you regard as being your sub-transmission system? A. The sub-transmission system, as referred to in this discussion, consists of the lines which form the connecting link between the main transmission system and the main power plant, with the distribution sub-stations. Those sub-stations are step-down transformers stations in most cases, which step the voltage down from some voltage such as 13,800 or 33,000 volts, to a lower dis- 6135
tribution voltage, such as 2,300/4,000, or in some cases 6,600, 6,900, and other similar voltages. That is, we have several such voltages in approximately the same range.

The sub-transmission system of the Union Electric Company Group is a combination of overhead lines and underground cables. The system includes more than 1,200 circuit

miles of both overhead and underground transmission, divided into 543.8 miles of 33 kv. pole lines; 43 miles of 33 kv.

steel tower lines; 159.7 miles of 33 kv. submarine and underground cables; 170.4 miles of 13.8 kv. submarine and underground cables; 248.2 miles of 13.8 kv. pole lines; 6.8 miles of 13.8 kv. steel tower lines; 1.6 miles of 11 kv. steel tower lines; 34.2 miles of 11 kv. pole lines; 9.1 miles of 11 kv. underground cable; and 18.5 miles of 6.6 kv. underground cable. These mileages are in addition to those lines which have been previously described as main transmission system.

In general, the underground system, so-called, meaning
6137 the underground cable and the conduit work, is confined to the urban and the more densely populated areas, while the overhead circuits serve the surrounding, lesser populated districts.

In general, the City of St. Louis is largely supplied by underground cable except for its 4,000 volt ultimate distribution circuits, which are not under discussion here.

St. Louis County has both underground cable and overhead lines, I would say predominantly overhead. The other less populated districts have a larger percentage of overhead construction.

6138 The general basis of these circuits is to supply off them 60-cycle energy for practically all of the growth of the load. Certain areas which are already supplied by 25-cycle for in-

—2,636—

dustrial purposes or railway load, are continued that way.

Q. Now, if you will, describe that portion of the subtransmission system in and about the Keokuk plant? A. The Keokuk voltage at the plant is referred to as 11 kv. Most of our system is 13.2 or 13.8 kv. I would like to explain that in the use of these voltages that are very close to each other,

such as 13.2 or 13.8, or 66 kv. or 69kv., those are all used synonymously. Actually, the voltage varies on such a circuit, and at the transmitting end the voltage would be somewhat higher than at the receiving end. So when I speak of 13.8 kv. cables, I am talking about the power plant end. If I speak of 13.2, it merely means that we are talking about the receiving end. But in any case, they may be regarded as synonymous.

The Keokuk sub-transmission system takes the supply of power at 11,000 volts from the plant and distributes it in 6140
the vicinity of Keokuk, and by reason of transformation to 33,000 volts, it is also supplied to Fort Madison and other towns in the vicinity.

The two 11 kv. feeders supply 3,500 kw. of frequency changers of the Central Illinois Public Service Company. One 11 kv. feeder supplies a 2,450 kw. frequency changer of the Illinois-Iowa Power Company.

Four 11 kv. feeders go to Hamilton, Illinois, which is located immediately opposite the Keokuk plant on the Illinois side of the river, where two of these four feeders sup-

—2,637— 6141

ply the Illinois-Iowa Power Company; and the other two, the Iowa Union Electric Company.

Three 11 kv. feeders go to the Keokuk terminal for 11 kv. distribution to the Keokuk and Jackson Avenue substations, and numerous customer sub-stations.

The Keokuk terminal is just a name for a terminus, not far from the plant.

Two 11 kv. feeders supply large customers. Those are big industrial customers who are heavy users of electric power for electric furnace application.

Two 33 kv. feeders go to Burlington, supplying nine sub-stations of varying capacities, which are operated by the Union Electric Group. The end of those feeders terminates at the Burlington sub-station of the Iowa Southern Utilities Company. I should explain that that reference includes the line which was discussed under main transmission system, but I have not included it in this mileage. The reason I have mentioned it here is that those various sub-stations which are tapped off of that circuit, were not included in the previous
6143 discussion. They are small stations to a large extent.

In addition to the above feeders, part of the sub-transmission system consists of the taps on the main 110 kv. transmission lines at Hull, and Meppen. Those points were discussed and located in the previous testimony, and in addition to their features as wholesale points, there is some

—2,638—

sub-transmission carried out to supply loads in the vicinity.

At Hull, seven sub-stations are supplied with energy over 33 kv. lines from that point, and in addition energy is sold to the Central Illinois Public Service Company for use in
6144 their own frequency changers located at Hull sub-station.

At the sub-station which taps the main line at Meppen, a 9,000 kilowatt step-down transformer, 110 to 66 kv. voltage, supplies a portion of the power going to the Central Illinois Public Service Company transformers, and frequency changers; and a 66 kv. No. 2 single-circuit line, which is carried to Alton. That line was mentioned yesterday.

At Alton there is located 6,000 kilowatts in step-down transformers. The line then continues to Hartford, where 8,000 kilowatts of transformers are in operation, and thence

to Lake Avenue sub-station in East St. Louis, which is 15.6 miles south of Hartford.

At Lake Avenue, 10,000 kilowatts in transformers supply 25-cycle service in the East St. Louis district, with a reserve supply, over three 13.8 kilovolt submarine cables from the Ashley Street plant. That is, the service in East St. Louis amounting to about 10,000 kilowatts of 25-cycle load in that vicinity, has a duplicate source of supply, and in the event that this circuit from Mappen sub-station were to be in difficulty, the service would be continued without interruption 6146

—2,639—

by cables going from the Ashley Street station under the river and over to Lake Avenue. In that district we have the large packing companies, the National Stockyards, and this service is quite important.

In general, as we go through this sub-transmission system, I should like to point out that the facilities are, in almost every case, if not all, arranged to provide duplicated service; that the extent to which duplicated service is provided in the area supplied by the Union Electric Group is a very high percentage. I think that is one distinctive feature of the 6147
Union Electric system, the extent to which our main customers have duplicated service.

Q. State the purpose of that duplication, if you will? A. The purpose, of course, of the duplicated service, is to render less frequent possible interruptions, and not only minimize the possibility or probability of interruptions, but to reduce the length of time if any should arise.

The success which a power company may have in the long run with these large industrial customers is, in my opinion,

to a great extent affected by the actual continuity of the service rendered, as well as the voltage regulation and quality of service. The fact that electric service may be rendered and be of lower grade is not always appreciated, but it is a fact that in industrial work, particularly, both regulation and continuity are of the greatest importance.

—2,640—

The supply of service by these underground sub-transmission cables is obviously more expensive than to do it with
6149 overhead lines, but the reliability is much higher.

Q. Describe the portion of the sub-transmission system in and about the Page Avenue sub-station in St. Louis, if you will? A. The Page Avenue sub-station has been previously mentioned as a main transmission sub-station, which is its chief function; in addition to that, however, there is a large group of sub-transmission feeders leaving this station, and in addition to that, quite a large building containing a group of distribution feeders which will not be described at this time.

When we constantly refer to the Page Avenue sub-station,
6150 it is because that station contains, in the same general location, all of these facilities.

The sub-transmission feeders supplied out of this substation are of considerable importance. The fact is that they are very important. There are ten 13.8 kv. 60-cycle feeders which supply ten sub-stations through 104,500 kilowatts of 13.8/33 kv. transformers; and 13.8/4.16 kv. transformers 25-cycle service, at 13,200 volts is provided by 24 feeders which run to 12 railway sub-stations belonging to the Public Service Company, which is the local street car company, and

some of these feeders go to Ashley Street where they in turn are supplying railway load.

—2,641—

The 60,000 kw. of frequency changers, previously mentioned, are on the bus which supplies all of these facilities, and I would like to make this point, that when some question was raised recently about the possibility of supplying reliable service to what is known as Lambert Field, an airport some 9 miles from Page Avenue sub-station, and I was asked whether I thought we could supply good service 6152
to that point, I said that I could conscientiously reply that if we couldn't deliver it at that point, I didn't believe it could be delivered anywhere. And I have summed up the facilities by saying that we had two hydro-electric plants, four steam plants, several duplicated types of substation facilities, and a group of distribution lines—all available at that point, and any one of which should be able to supply that service many times over.

The extent of these facilities is a matter of real point in this particular system. The St. Louis County area, which is adjacent to this sub-station, contains the highest grade 6153
residential and some of the better commercial establishments in the St. Louis area, including University City, which is the largest single town in that district, and the requirements for service are very severe at that point.

The ten feeders previously mentioned, 7 of which supply energy to transformers having a total capacity of 82,000 kilowatts, which furnish the service for nine sub-stations,

—2,642—

are divided into two groups: seven 33 kv. feeders, and three

feeders supplying the Page Avenue distribution station through 22,500 kilowatts of transformers at the lower voltage delivered of 4,160 volts, three-phase, four-wire.

The statement there is not sufficient to make it clear. The seven 33,000 volt feeders which leave this sub-station, each one having its own transformer, step up and supply 33,000 volt overhead lines which go out several miles in the different directions to supply these step-down sub-stations, which in turn handle the district for such towns as St. Charles, for
6155 example, and various other communities in that area.

The three feeders which I mentioned as going through the 22,500 kilowatt transformers, step down right at the Page Avenue location, and go into this other large distribution building which handles the 4,000-volt distribution.

The 25-cycle sub-transmission circuits from Page Avenue, consisting of 24—13,200 volt feeders, have 8 feeders used as tie-lines to the Ashley Street plant. These are underground cables. Also, ten feeders supplying 12 sub-stations of the Public Service Company, by underground cables. You understand that 10 feeders can supply 12 sub-stations by tap-
6156 ping one feeder to more than one. That sub-station probably has another source of supply from some other location.

Six feeders leave Page Avenue underground, and then are routed overhead, three going north, and three south, to a

—2,643--

number of customer sub-stations.

That is a rather brief summary of a major investment in feeders whose average capacity varies from a minimum of 7,500 or 8,000 kilowatts each, to 12,000.

All of these transformers on those feeders that step up are provided with air-blast equipment which permits the

transformer to increase its rating for emergency operation. The later transformers installed on some of these equivalent feeders are rated 10,000/13,333 k. v. a., that meaning that the transformer which has a 10,000 kilowatt self-cooled rating, with the radiators exposed to the air in a normal manner, can automatically, by the operation of relays, turn on some motor-driven blowers which blow air rapidly over the surface of the radiators in the transformer, and raise the capacity of the transformer.

This is used in connection with reserve service. If one 6158
line of any three of those were to go out of service, the other two would pick up the load.

Q. Now if you will, describe the portion of the sub-transmission system in and about Ashley Street? A. Ashley Street station, which was previously mentioned, has been in service for many years, has the ground around the station for a distance of about a block almost paved with cables. I believe that that statement is hardly much of an exaggeration. Literally, it is getting difficult to find room to put any more

—2,644—

conduits in that immediate vicinity, and the temperature rise 6159
of such cables has to be carefully analyzed as larger numbers of them are involved in close proximity, and each one contributes a certain amount of heat and the ground has to radiate it.

Ashley Street both generates and distributes 60-cycle and 25-cycle energy. The sub-transmission system at Ashley Street may be summarized for 60-cycle energy as: 21 feeders going to six sub-stations, including the downtown AC low-voltage network. This network is a relatively recent installation, and will be discussed in more detail later.

6160

The 25-cycle system supplies energy to six sub-stations over 18 feeders, and also serves 13 Public Service Company (railway company) sub-stations over 13 feeders.

Q. Now have you stated the voltage of the feeders going out of Ashley Street? A. No, I shall do that.

The steam mains out of Ashley Street are large, and carry 200-pound steam pressure, and there has to be great care exercised where the steam mains and the cables are in the same vicinity, and problems of that type are the result
6161 of concentration of load in congested city areas. Such problems are not encountered in lower-load-density districts, but they frequently present real difficulty for satisfactory solution.

In this case, we have to highly insulate the steam mains,

—2,645—

and then provide special facilities for cooling the conduits, and one of our very large customers is a refrigeration company which has 10 to 15 miles of distribution refrigeration service. They pump the refrigerant around the city and expand it at different locations. Although we work very
6162 closely together to eliminate any problems that may arise, we get into some street intersections where the refrigerating company and the steam heating mains, and all the electric cables, converge. The steam heats the refrigerant, which causes it to expand and produces difficulties in pumping it, and the steam main also may have a detrimental effect on the electric cables; the electric cables may affect the refrigerating line, and they are not very good neighbors.

There is only a certain amount of space left in these streets, and we have to utilize what there is with the greatest care.

The voltage at which the energy at 60 cycles is handled out of Ashley, is largely at 13,800 volts. There are 25—13.8 kv. feeders (four tie-lines to Cahokia with 43,500 kw. in 13.8/33 kv. transformers). I have got to mention that at this point because, although it is located there and is intimately connected with this sub-transmission system, it was referred to and classified with the main transmission system, that is, those four feeders. They tie between the Cahokia station and Ashley Street station.

—2,646— 6164

The balance, twelve 13.8 kv. feeders, go to five sub-stations and customer sub-stations, and six feeders go to the down-town network transformers.

The sub-station which we refer to as No. 6, and which is located within the Ashley Street power plant building, is a 4,160-volt, 3-phase, 4-wire distribution station.

There are three generators connected to the 4,160-volt bus, having a combined capacity of 42,000 kilowatts, and in addition, three feeders connected to the 13.8 kv. bus, through 27,000 kilowatts of transformers. That is, there are several buses in Ashley Street, all of which are duplicated, again at increased cost, to obtain better service, and these buses are each used to supply certain load at the respective voltages, and in addition, each of these buses is connected with one or more of the others by a tie-transformer and cable. 6165

The application there sounds complicated, but is relatively simple. It simply means that we have generation at more than one voltage, and on more than one bus. We have distribution to these sub-transmission cables at more than one voltage. And in order that there may be available reserve

service, each of these buses for the other, they themselves are tied together with sizeable transformer banks.

In the 25-cycle portion of the plant, there is a 6,600-volt bus to which four turbines, aggregating 56,000 kilowatts, are connected, and to which 25 feeders are connected.

—2,647—

Fourteen of the 6,600-volt feeders supply five D. C. stations with energy for their conversion equipment. Those stations are going to supply the Edison 3-wire D.C. system.
6167 Seven of the feeders go to five Public Service Company sub-stations, and four feeders connect to 34,500 kilowatts in what we call Sub-station No. 9, also located at or very close to the Ashley Street power plant building.

Sub-station 9 has four transformers of a total capacity of 34,500 kw., as mentioned above, which step the 25-cycle energy up to 13,200 volts; also eight 13,200-volt tie-line cables connected to Page Avenue, over which the 25-cycle energy can be exchanged.

More simply, and to clarify the general relationship, the Keokuk energy generated at Keokuk comes to St. Louis over
6168 the high-voltage main transmission line, is delivered to Page Avenue, from which point that energy can either go to the frequency changers and be converted and placed on a 60-cycle bus, or it can go down over these 13,200-volt underground cables to this Sub-station No. 9, which is Ashley Street, and there tie in on a 25-cycle bus to which the 25-cycle generating equipment is connected. ~~Off~~ of that bus there are distribution circuits, sub-transmission, which take the energy out to primarily the Edison sub-stations for conversion to direct current.

I believe that describes that part of the plant sufficiently.

—2,648—

Q. Now, if you will, a similar explanation as to the portion of the system in and about the Venice plant? A. The Venice plant is not so complicated, it does not have so many facilities. It gets its power away from the plant, in general, by higher voltage lines and less of them. The Venice plant at this time has three 33 kv. cables supplying sub-stations in St. Louis. Those are submarine cables across the river.
It also has two 66 kv. tower lines which supply transformers 6170
of 48,000 kw. capacity in Federal Sub-station at Alton. That sub-station will be described later.

The Illinois-Iowa Power Company receives power at 66 kv. and transmits it over their own double-circuit tower line into Illinois towards the north and east, going to Staunton and a sub-station site known as Stallings. We have no connection with that other than to sell them power at the power plant site.

The sub-transmission system at the Venice plant has
three step-down transformers of a combined capacity of 40,- 6171
000 kilowatts, reducing the voltage from 66 kv. to 33 kv., and supplying the cables previously mentioned, which go to St. Louis, to two sub-stations.

There are also two 66 kv. feeders, previously mentioned, going to feed sub-stations at which point the general service for the entire Alton district is supplied. The details of the capacity of that station will be reserved for a little later

—2,649—

discussion. It is rather a major station in our system.

The Venice sub-transmission system, under discussion here, is being modified and supplied in a somewhat different manner at the present time, due entirely to the construction of the new Venice station.

The concentration of all of the power in that location
at 66,000 volts, without any segregation by transformers,
would produce, by the time the plant was extended to its
second section, such heavy short-circuits that system relia-
bility would be impaired. This does not mean that we could
6173 not go ahead with the present service as now rendered,
which is highly satisfactory, but it does mean that at some
time in the future we might be required to change the meth-
ods. We have looked into that matter carefully, and ana-
lyzed the possible effects on service, and have decided that
we are justified in spending the necessary money today to
connect those circuits into the new plant onto the 13,800-
volt bus, and we are purchasing new step-up transformers to
do that. That is a question which in many cases, I think,
might be resolved on the theory that everything is all right,
why not let well enough alone.

6174 We could save the price of four large transformers if we were willing to risk the reduction in the grade of service on the system. We have obtained approval to buy these transformers. —2,650—

I like to bring these points out, because they represent the added investment that is necessary in a system of this kind if you intend to deliver the very best grade of service which you possibly can, and in a concentrated district, I think that that is the only attitude to take. The service demands that type of reliability.

I have very little else that I think need be mentioned there at Venice. These three feeders which have been described will be removed, the transformer will be removed, and used elsewhere, and the new transformers will be located in a row along the river on top of the levee, and each one of these will be supplied directly from our new 13,800-volt buses which were mentioned yesterday in the design of the new plant, and feed across the river very similarly to the Cahokia feeders, through the underground submarine cables.

Q. Turning now to the Cahokia plant, will you give simi- 6176
lar information as to the sub-transmission system in and about it? A. The facilities in and about Cahokia are, of course, many times more extensive than any of our other stations, and yet there is ample room to get all of these facilities out in an orderly and very simple manner, which we now appreciate. That is to say, the judgment which was used initially in locating Cahokia and in acquiring adequate land when the company obtained it, and in anticipating what the picture would look like 20 years later, has certainly paid

—2,651— 6177

dividends. That is to say, it is making the station one of excellent design today, whereas a lack of such foresight would have crimped the situation entirely.

I like to point to Cahokia as being a station with as many facilities going out of it as any that I know of, and yet it does not appear to be congested, and it is operating with perfect reliability.

The difficulties at Cahokia are few and far between, and never very serious.

6178 *Stanley Stokes—By Respondents—Direct*

The plant has two 66 kv. circuits leading from the outdoor sub-station in the yard, supplying power to the Illinois-Iowa Power Company at Belleville. Those two feeders have been previously mentioned under our main transmission system, but because we are describing the supply to this area, I mention them again.

Three 33 kv. feeders go to a sub-station in East St. Louis, known as Winstanley, as well as one known as Main, and Lake Avenue sub-station.

6179 Three 13.8 k. v. feeders supply a large number of customer sub-stations in East St. Louis, and the surrounding industrial area. That is, these three feeders, which have a capacity of roughly 3,500 to 5,000 kilowatts each, go around and tap various industrial plants where the plant itself owns its own sub-station. We supply them with power.

— 2,652—

The larger portion of the power from the Cahokia station crosses the river into St. Louis through a combined total capacity of 202,500 kw. in 13.8/33 kv., step-up transformers. These cables supply power to 12 A. C. sub-stations
6180 which are connected through 24—33 kv. submarine cables, where they cross the river, and thence, by ordinary underground lead cable in ducts, to the sub-station. One A. C. sub-station is supplied with power by two 13.8 kv. cables.

Four D. C. sub-stations receive power over four 13.8 kv. cables. This makes a total of 17 A. C. and D. C. sub-stations supplied by 30 cables.

At this point I would like to digress just a moment to illustrate that when we were describing the 25-cycle system at Ashley Street going into the sub-transmission feeders,

we mentioned that some of those feeders supplied the substations which convert from 25-cycle to D. C. Now from Cahokia you have a similar group of 60-cycle feeders which go to similar conversion sub-stations to convert to the D. C. for the Edison system.

Thus we have about 34,000 kw. all told of Edison D. C. load which is about equally supplied from 25-cycle and 60-cycle systems. Thus, the most severe case of trouble that you could conceive, which might conceivably, under that assumption, shut down one whole system, either 25 or 60-cycle, would still affect only half of the Edison system, be- 6182
cause they are not electrically connected between the 25

and 60 cycles in such a way that they can possibly affect each other to any extent.

Thus, the degree of reliability which we have obtained on the Edison system by the use of the two frequencies in that manner, would be impossible, as far as I know, to obtain otherwise. The record of this Edison system has been very good indeed.

Q. Where is the Edison system located? A. That Edi- 6183
son system represents the main downtown, heavy business district, running about 10 or 11 blocks north and south, and possibly 16 to 18 blocks east and west. It is a very small and dense area. The load density in that area is comparable with any part of New York except a very few blocks right in the Manhattan area. It is higher than the density of New York outside of that point. But it is a very small area, it only measures .4 square miles. It has, at the present time, about 75,000 kw. in that little area, which, if you divide it by .4, is a very high load density.

The additional load in that area is being taken on the A. C. low-voltage network.

I think no further details need be mentioned of the tie-system between Cahokia and Venice, or rather Cahokia and Ashley Street. There are transformers at Cahokia which supply these tie-cables to Ashley Street, just as there were at Ashley. Those cables, by the way, are 450,000 cm. conductors, on those tie-lines, whereas the majority of our cables

—2,654—

6185 are 350,000 cm. Those are large cables.

Q. Now, similar information as to the portion of the system around the Rivermines plant? A. Rivermines, as you will recall on Exhibit No. 51, was located at the southern end of our system, and is a major switching station on the Osage-Rivermines-Crystal City-Cahokia circuit. That can all be regarded now as one transmission circuit. We described it in sections yesterday, but it is all contiguous, and this switching station at Rivermines permits the segregation of that circuit into the section running between Rivermines and Osage, or between Rivermines and St. Louis, by auto-
6186 matic, high-voltage switching, in such a way that as long as any one of the four circuits feeding into Rivermines is available, service can be supplied. The result is that the St. Joseph Lead Company, with roughly 27,000 to 30,000 kilowatts of mining load, depends exclusively on our service for their operations, which is quite a compliment to the service. They had always felt that in addition to any kind of outside service supply, they should have a reserve steam plant, too. We have the plant there but we don't find it necessary to operate it; they do not insist upon it. When

they used to carry their own load with their own plant, they had an insurance policy with Lloyds which would pay the most fabulous sum in case a tornado took away their plant. I wish I could recall the exact figure, because it showed a

—2,655—

good example of the attitude that they had as a measure of the value of that service. If that plant should be blown away, they would be paid something on the order of $50,000 a day for the length of time required to rebuild it.

Q. From whom was the Rivermines plant acquired? 6188
A. We purchased the plant from the St. Joseph Lead Company.

Now in connection with this switching station which is the means of furnishing continuous service on these Osage circuits, we have located at Rivermines two 25,000 k. v. a. synchronous condensers. Those are rotating machines which are used to control the voltage on the transmission lines. It is a peculiar fact, well known to electrical people, that what is known as a leading current, meaning a current in which the voltage lags behind the current in the ordinary oscillation, if it were to be plotted you would find the current 6189
leading the voltage by certain angular degrees. When we have a leading current flowing through an inductance, a voltage drop is obtained. This voltage drop, instead of subtracting from the generating voltage as an ordinary voltage drop would do, is added in such a direction—this being a vector addition—is added in such a direction as to cause the voltage to rise. It is a rather peculiar phenomenon, but advantage is taken of that fact so that by operating a machine which is in all respects equivalent to a generator or motor,

—2,656—

6190

with a very high field excitation, that machine will absorb the reactive flow of power, cause a leading current to flow in the main transmission line, and when flowing through a transformer will actually produce a voltage drop which adds to the generated voltage in such a way as to increase the total. The voltage at the end of the line, removed from the generator, can be made to rise instead of drop.

Those machines are automatically controlled to maintain voltage at any point desired, and to maintain the power
6191 factor of the transmission line as required.

Those facilities, again, are a measure of the service reliability. One of those 25,000 kw. machines is adequate to handle the transmission system. The other one is in there purely as a reserve unit and for additional reliability.

Off of this sub-station is tapped a transformer station, and that transformer station supplies a sub-station containing a number of 6,900-volt feeders. Those feeders supply the St. Joseph Lead Company direct. It has on the order of 50,000 k. v. a. of distribution transformers scattered around over the mining district there.

6192 In addition to that, this same step-down sub-station from 138 kv. down to 6.9 kv., supplies another sub-station from which several 33,000-volt supply feeders radiate to handle that area for normal commercial and residential purposes.

—2,657—

The switching station itself at this point, on the low-voltage side of the transformers, consists of a four-story building, filled with oil switches and cells and structures, just as any power plant would be, and the switchboard itself is, I should say, approximately 200 feet long, with one panel right after another. It is a very large installation.

 6193

I should like to give some detailed figures as to the number of these circuits which I have just described.

There are twelve 6,900-volt main feeders; two 6,900-volt feeders go to 15,000 kilowatts of 6.9/33 kv. step-up transformers, through oil circuit breakers, to a 33 kv. outdoor sub-station. That is the one that supplies the local area through five 33 kv. overhead lines. Those lines go north to Festus, Missouri—I don't believe the town is indicated on Exhibit 51, but it is adjacent to Crystal City, which is shown on the exhibit; also to a number of other towns in the surrounding 6194
district there, among which I can mention Farmington, Bismarck and Fredericktown, the latter being shown on Exhibit No. 51.

Two feeders supply the towns of Flat River, Bonne Terre, De Soto, Victoria—these towns all within a radius of 25 or 30 miles of that station—with service. This circuit, which was mentioned as going north to Festus, is primarily used as reserve supply for that town, it having another source at a sub-station at Crystal City which is shown on the exhibit.

—2,658—

6195

One circuit out of this Rivermines sub-station delivers energy to the Arkansas-Missouri Power Corporation for their supply in Southeast Missouri. That is not a major connection and I am not sure whether it is shown on this exhibit, Exhibit 51. Yes, I find it is shown here as "A-16", the point of delivery.

At Crystal City, which is indicated on the exhibit, we have another sub-station which supplies primarily, first, the plant of the Pittsburgh Plate Glass Company, a large glass manufacturing industry who receive service at main transmission

voltage of 138 kv., and who transform it down through their own transformers, and who own their own sub-station.

That is a very extensive and very interesting connection at that point. That is just a couple or three spans away from that river crossing which we described previously, and the difficulties of construction continued right on over to the plant. There is a very high bluff and some rugged hills and then a railroad yard and a small river or creek, with no place to locate towers. So the last span into the Glass Com-
6197 pany had to be carried for some distance and terminated on a tower 150 or 175 feet in height, in the Glass Company's yard, which they themselves provided.

It is a very rugged structure. Also, due to the alkali fumes which the Glass Company emits, we had to change from an aluminum to a copper weld steel in this last span. It also developed that we had to terminate on this receiving

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structure in a horizontal position and were leaving the top of this high hill in a vertical position. The middle arms of this double-circuit tower had a large offset, that is, they were
6198 longer than the top and bottom, and in attempting to rotate these circuits from the vertical to the horizontal plane, with that offset in the arm, you cannot obtain safe clearances in the middle of the span. We anticipated the difficulty and made up a few model spans, and convinced ourselves that it just wouldn't work that way. So we located the long arm at the top, and rotated the two circuits in opposite directions. That changed the phase position of the conductors on the terminal tower.

We notified the Glass Company of this position, and gave them a diagram showing the position of the conductors. In

other words, if you numbered them they would be A, B, C—B, C, A, instead of A, B, C—A, B, C—and even at that, they got into a little difficulty in the preliminary development of the problem, because they didn't particularly receive our diagram with sufficient care, having been used to using single-phase transformers, and figuring that they could make their connections anywhere they wanted to on the low-voltage side of the transformers.

As an actual fact, when they went to make these connections they found that they had to make a change in the trans- 6200

—2,660—

formers to do it.

Service has been very satisfactory with that customer,—in fact, it has been one of the satisfactions in my work to deal with that particular customer. I made the original arrangements, and have negotiated with them from time to time in connection with change of contracts, and in every respect the relationships have been extremely satisfactory.

We, in one or two cases, felt we were leaning over a little backward in the arrangements that we made with the customer, but at a later date we wanted to change the service 6201 and extend these lines to Rivermines, and the customer reciprocated, and we felt well repaid.

The sub-station at this Crystal City plant of the Pittsburgh Plate Glass Company is operated jointly by ourselves and the customer for our mutual economy. That is a rather interesting situation there in which they have their own operators, we have the communication lines in there, we divide the cost of operating the sub-station, and in turn they supply to us through their transformers, voltage which

6202

we step up to 33,000 volts, and in turn we supply our local area at Festus, Crystal City and Herculaneum, three cities adjacent to each other.

That arrangement has been very much cheaper than for each of us to do ~~this~~ thing by ourselves. In addition to that we have, within the last year, negotiated a contract

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which gives us permission anytime we wish, to install our own transformers, of larger capacity, in their yard, and to

6203 utilize all of the facilities of the high tension spans, towers, switches, and so forth, and supply our own service with them, thus giving them the full capacity of their own banks. This anticipates a joint growth of load on their part and ours, too, and it is interesting to realize that after operating on a joint basis since 1925, we are both willing and glad to enter into an agreement to continue such operations.

That sub-station has two 10,000 k. v. a. transformers, stepping from 132 kv. to 2,300 volts. We step it back up from 2,300 volts to 33,000, through two 3,000 k. v. a. sub-stations. At the time this agreement was entered into,

6204 we had just gone into the new district and were supplying service and had a load of only about 650 kw. ourselves. That load has multiplied many times since then, but we could not have justified a separate high-voltage sub-station for our own purposes. At the present time our load is big enough so that we could justify it, but we still find it economical to work this joint arrangement, although we are going to eliminate the double step-down and step-back-up voltage practice.

There is one other sub-station which I should like to mention, and it is located on the north route of the 138 kv.

transmission line between Osage and Page Avenue, and is marked as a square with the letter "A" on Exhibit No. 51. That is located in Franklin County. That is, as far as I

—2,662—

know, the only fully automatic, high-voltage sub-station of its type, although others are in contemplation.

It has been operating with great success for two years. It has two high-voltage switches which connect on the 138 kv. lines, an automatic transfer system to provide a certain type of selective service; one bank of transformers which step the 6206 voltage down to 33,000 volts; and the low-voltage facilities.

One of the interesting features of this sub-station is that it was intended to be a fully automatic, unattended station, located out in a country district some 6 miles from the nearest town. The requirements were that no operations of this station should interfere with the service of the main transmission iine in so far as it is at all possible to do so.

So far, no such interference has been observed. This requirement, however, placed very serious restrictions on the time available for relay and switching operations. The stability limits of the Osage-Page circuits were such that 8 6207 cycles was the longest time that we were permitted to use in clearing the circuit in case of trouble. If a short-circuit were to occur on one of the outgoing 33 kv. feeders, from this Franklin County sub-station, and if that short-circuit were adjacent to the sub-station, calculations showed that it would

—2,663—

be able to interfere with the main transmission line.

Therefore, we would have to get that service off even quicker. The result was this, that we developed, in consul-

tation with the General Electric Company, a device which
they call a relay, but which is really about half a dozen or
so relays, mounted in a glass case, and those relays measure
the distance of this accidental fault from the sub-station.
If that fault is more than a mile and a half, we delay the
operation of the 33 kv. switching, giving time for the in-
dividual 33 kv. supply lines that go out through that district
to clear. By that I mean, if you have 5 such circuits, which
we have, if there is trouble on one of them, we wouldn't
6209 anticipate that, but we will let it clear itself if it can be done
within 10 or 12 cycles.

If, however, that fault is closed to the station, this relay
system uses a little judgment and we clear out the main
switch in the sub-station, which will interrupt all five of
those 33 kv. circuits, rather than interrupt the main trans-
mission line, and then they are all re-closed immediately. I
should have mentioned that this station is not only auto-
matic on the transfer from one circuit to another on the
high-voltage line, but also automatically reclosing and final-
ly locks itself out and rings a bell after the third operation.
6210 It has only locked out once, as far as I know, and that was
due to a snake climbing 30 feet up a steel structure, which

—2,664—

they are not supposed to do. When I say that, I mean that
it is the general belief out West in the prairies that if you
lay a lariat or steel cable or steel rope around your tent, a
snake will not crawl over it. I used to do it with regularity
when I worked for the Utah Power & Light. But there is a
slight spitting due to corona on these sharp points around
such a station, and it makes a little hiss, and the natives

have assured us that the snake thought there were some birds up there, and went up after them. We got the snake, but he didn't get the birds.

That instance was the only lock-out that we have had, that I know of.

This sub-station in Franklin County is designed to replace the present transformers with larger ones at any time that the service requires it, and the sub-station can readily be brought up to any convenient capacity, such as 25,000 or even 50,000 kilowatts. The immediate requirements are 6212
small, and the present capacity is, I believe, four 3,333 k. v. a. transformer units.

The units themselves are single-phase. The reason for that was that the weight of the 3-phase transformers was too great to handle over the roads and the bridges, and even taking the ones we did, we had to block up under some of the bridges.

I think that covers the main sub-stations of Rivermines, Crystal City, and the Franklin County sub-station.

—2,665— 6213

The Examiner: Let us have a short recess at this time.

(Whereupon, a short recess was taken, after which the hearing was resumed.)

By Mr. Hamilton:

Q. In addition to the sub-stations you have already referred to, in the sub-transmission system, are there any

other sub-stations of major importance in the system? A. Yes, there are at least two important stations that I should like to mention. They are a little different than the stations so far mentioned, namely, in that they are large sub-stations at the end of the sub-transmission system.

One of them is the Federal station at Alton, which covers what we call the Alton district. The town lies about 25 miles north of East St. Louis, and has considerable heavy industrial load in the area. The sub-station is supplied from
6215 the two 66,000 volt lines that go north from Venice to Alton, and it, in turn, is a switching station and transforms the voltage to 33,000 volts, and distributes it over a number of rather high capacity 33,000 volt circuits, going to such customers as the Laclede Steel Company, and the Owens-Illinois Glass Company.

It also supplies a sub-station for the City of Alton, known as the Liberty Street station.

The capacity of that station at the present time is 48,000 kilowatts, and the circuits having been recently enlarged, we

6216 —2,666—

expect to transmit ultimately 45,000 kilowatts on either circuit, and will expand that sub-station.

The load is growing very rapidly in that district. Included in the customers supplied from this, I should not overlook the Shell Company. They have a load which has been increasing at the rate of from 500 to 1,000 kilowatts a month for the last six months, and an anticipated load of about 14,000 kilowatts by the end of next year. The present load is around 12,500 to 13,000.

Loads of that character are quite a responsibility for an electric company, and we have had very successful service for that refinery.

The other sub-station which I should like to mention is the Webster Groves station. This is located in St. Louis County, west a few miles from the St. Louis city limits.

Three 33 kv. circuits from the Cahokia plant are brought in to the 33 kv. outdoor sub-station at Webster Groves. From this sub-station, two 33 kv. circuits go west and north, supplying energy to the various towns and villages, and supply- 6218
ing a reserve circuit which goes to Franklin County and ties in with that automatic sub-station which I have previously described here.

In addition to the switching station supplying outgoing 33 kv. feeders at Webster Groves, it also supplies considerable capacity in step-down distribution transformers for local distribution. That will be covered a little more ex-

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tensively in our discussion on the lower-voltage distribution system.

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I believe that that covers all of the sub-stations which I feel should be specifically described. You appreciate that there are a large number of these stations which are of a somewhat lesser importance than those mentioned, and I could go into a detailed description of them for hours. But the typical larger ones have been described.

Q. Is the sub-transmission system in the St. Louis area designed to insure reliability of service? A. It very definitely is. That is a point that I alluded to a little earlier in my discussion, that the multiplicity of interconnections of these

33 kv. sub-transmission circuits in St. Louis, and St. Louis County particularly, and to a large extent in the rest of the area, provide an opportunity to restore service, in the event of outage, very quickly, and in addition to that, provide sufficient capacity that such outage should have no effect on the service itself.

The 33 kv. circuits in St. Louis County criss-cross in the form of squares on most of the main roads, and by changing the disconnecting switch positions, the circuits can be routed
6221 in different configurations, so that our Page Avenue substation could supply the City of Kirkwood, for example, or Kirkwood could have been supplied equally well out of the Webster Groves station. In the event there is any highway

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work going on, of which there has been a great deal in recent years, we try to keep at least one reserve circuit supplying these major communities, on a highway which is not being constructed, that is, the pole lines are either parallel with the highway or back on private right-of-way a few feet. And there is always the possibility of the highway work causing
6222 some damage, due to blasting or otherwise. So the facilities for interconnection are very extensive.

The feeders for this sub-transmission system are operated in parallel on the low-tension side of the transformers, that is, the cables leading from the main high-voltage transmission system out to this receiving sub-station are usually operated as a cable and a transformer, each cable having its own transformer, and the switching being done on the supply side of the transformer at the source, and on the receiving side of the transformer at the receiving end.

The result is that we keep the short-circuits down by that method.

On the low-voltage side of the receiving sub-station, we have a regular standard bus construction with all the low-voltage circuits in parallel, supplied through oil switches.

Q. You referred to the rather extensive use of underground cables in St. Louis, and the area more or less contiguous to St. Louis, in St. Louis County. Is the matter of cable loadings a subject of considerable investigation by

—2,669— 6224

the Union Electric Group? A. Yes, it is. We have had to do rather an unusual amount of work in this connection in establishing suitable cable ratings, the reason being that St. Louis has very high ground temperatures in the summer. Our water mains reach a temperature of 90 and above in dry, hot summers, and we have had a temperature of 94 in the Mississippi River water at that point.

—2,670—

To bring out the extremes to which some of those conditions got to in 1936, which was our all-time hot year, the river water going into Cahokia at a temperature above 90, 6225
went through the boiler room concrete floor and into the shower baths, where the men cleaned up after working hours, and the water got so hot that they couldn't take a bath. That was just due to the temperature of the water all being—already being 95 when it came into the building, and passing through the boiler room floors where there was heat in the concrete, and the cold water got so hot that they couldn't stand it and complained. That condition is not general. Therefore, other cities can be of little help to us, and we have to work out our own rating by experience.

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We have gradually developed a sort of discount table that we can apply to what are generally conceded to be conservative cable ratings, and we have to use a little lower rating in the summertime. We establish what we call emergency rating on a cable, and that is the highest load which we will put on that cable in the summertime. Then we have a normal rating which represents the maximum load that we would be willing to carry on the cable at all other times. Those loads have to be taken into consideration with the number of hours
6227 which they operate because the cable and duct system heat up gradually as the load is increased.

A cable which has been running cool over Saturday and Sunday, can carry much more steady load Monday than it

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could on Tuesday, because it has had 36 hours to cool off. The result is that the matter of cable ratings is really a complicated subject.

Our present conclusions are these. A 450,000 cm. which is the largest size we use regularly in the 33,000-volt service, is rated at 13.8 kv. at 7,730 k. v. a.; at 33 kv., at 16,500 k. v. a.,
6228 each.

The normal operation of such a cable would be to have two supplies to a sub-station. The result is that the normal load would be 50 per cent. or less, because there will be two cables supplying this load. And the only time that the load would go up to these values would be when one cable is out. Now, of course, it is entirely likely—in fact, it is very probable—that neither cable will be out during the hot weather, in which case we could have increased that load to possibly a couple of thousand kilowatts higher, but we can't assume

 6229

that, so we limit the emergency rating, which is the rating we will put on the cable when the other cable is out of service, to these values.

For a 350,000 cm., 3-conductor cable, which is the one we use the most of, we have 6,680 k. v. a. at 13,000 volts, and 14,500 k. v. a. at 33,000 volts.

The other two sizes, which are in rather general use, are 4/0, rated at 5,030 k. v. a. at 13,000 volts, and 11,000 k. v. a. at

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33,000 volts. The smaller one, 1/0, is similarly rated at 6230
3,480 and 7,400.

If we have a large number of these cables in a duct, or if we know that there are other cables in the street adjacent to it, we apply a correction factor and reduce the rating accordingly. In other words, we have got to make allowance for the total heat liberated within a given ground area, and as a result of considerable study and analysis of the life of cables in the St. Louis district, we feel fairly satisfied with these ratings. There is one question, however, and that is it is entirely possible that some of these emergency ratings
can be materially increased without actually damaging the 6231
cable. That is receiving much study at the present time.

Damage to cables is being carefully analyzed and a post mortem, so to speak, carried on after each cable failure, with extreme care, trying to find out why the cable failed. We found that, among other things, the creepage of these cables in the ducts, due to expansion and contraction with temperature changes, was such as to cause a crystallization of the lead at the point where the cable leaves the duct and goes into the manhole, and that many of these failures were

attributable to such causes as that, and not directly to the high temperatures. If those prove to be the majority of the troubles, then it will be possible, by using more care in the design of cable and duct arrangements, to actually run these cables to much higher temperatures without damage.

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There are some experiments being carried on to determine that, and it takes several years to be sure of these figures. It would mean a great deal to any company to be able to
6233 increase these ratings by even 10 per cent., because the investment in the cable system is huge.

One other expedient that has been adopted is this. Where we go through a soil that we know to be particularly a poor heat conductor, for example cinders, a cinder fill, we have learned to increase the size of the cable. We will put in a section of 450,000 cm. in a cable where the rest of it is 350,000 cm., thereby reducing the losses in that section, and hence reducing the heat and keeping the temperature down that way.

Q. Are the present sub-transmission facilities of the
6234 Union Electric group adequate for present loading and for presently anticipated loading? A. They are, and in addition they have a large reserve capacity. The approximate ratio of loads on some of these cables, to their maximum capability or capacity, may be illustrated.

The particular examples that I am using here are taken from some alternating current sub-stations in the City of St. Louis, but it would be equally applicable to any of the others. These happen to be more convenient to obtain the information on.

—2,674—

In a list of 23 stations which I prepared, the highest loading that I could find was 75 per cent. of the capacity of the transformer banks, and this occurred at the Page Avenue station. That station is scheduled for an addition in the near future.

The next highest loading in this group was 67 per cent., at a station known as Lesperance. That is still satisfactory down there at that station because of the interconnection with other stations. If that were 100 per cent., we could
still operate satisfactory because we have ties with other 6236
stations that would carry part of that load.

In general, looking over this group, we find figures as low as 28 per cent., 30 per cent., 32 per cent., and the result is that the average ratio of load to capacity does not exceed about 50 per cent.

Q. Now, that percentages, is that the peak on the particular sub-station? A. The peak on the particular sub-station, yes. It may not be at the time of the system peak. That has no interest to a particular sub-station. It is only concerned with its own annual peak.

I might explain why there is as much capacity in some 6237
of these stations in reserve as there is. That is, if there could be any criticism of this ratio it would be that we haven't got these stations loaded up high enough.

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The answer is that a good many of these stations are relatively new, and it is not practicable to put in these high voltage underground cables and ducts in small sizes. The duct cost is high, and the cost of a 10,000 kw.-33 kv. cable is only slightly more than one of smaller size. In other

words, the insulating requirements are the same, the lead sheath isn't much different, and whether you put a small wire in or a big wire, you have spent pretty near as much money.

Therefore, it is better to put them in as big as you intend to put them in ultimately, even though you have to carry the fixed charges for a few years. The result is that we change transformers as needed, and ship them from the larger stations to the smaller ones, but cables are usually
6239 put in with ample capacity, and in these downtown or city stations, we put the transformers in to match the cable. Within a few years that ratio will be higher on these low values. The low values will increase, in other words, we will have the stations loaded up to a higher ratio, but the high values will be kept down for transfer of load or adding additional capacities. In general, there is ample capacity in this system to handle much additional load.

Q. Now, will you summarize the number of feeders on the sub-transmission system, giving a total figure, if you will? A. The sub-transmission system has a total of 226
6240 feeders on both the 25 and 60 cycle systems, and they are approximately equally divided between those two.

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As an example, I have 66 kv., 60 cycle feeders; 25 cycle and total.

There are 6-60 cycle feeders; 3-25; and 9 total.

Now, if I go through the different voltages and the different frequencies in that manner, I arrive at 117-60 cycle feeders, of all voltages from 66,000 volts down to 6,600; and 109-25 cycle feeders, or a total of 226. These are not to be

confused with the ordinary small distribution feeder, but they represent capacities from 5 to 15 thousand kw. each.

Q. At the outset of your discussion of the sub-transmission system, you indicated that the sub-transmission system represented the link to the distribution sub-stations. Turning now to the distribution sub-stations, you are able to state the total number represented in the Union Electric Company group? A. These distribution sub-stations which receive their power from the sub-transmission system and distribute
it to the moderate low voltage distribution sub-stations, rep- 6242
resent 63 alternating current and 9 direct current sub-stations in the Union Electric group, with an investment in excess of $11,600,000 in land, structures and equipment.

The total connected capacity of these stations is 643,000 kilowatts and they range from a 100 kilowatt station to one of 42,500 kilowatts. That summarizes the distribution stations.

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Q. I think you might state at this point, in order to clarify any description you may give of the distribution sub-stations,
the general character of your distribution system, whether 6243
network, radial or direct current? A. Our distribution system is, to a large extent, what is known as the radial system, preponderantly so. This is the result of long years of historical growth, combined with many factors that made this the most economical arrangement for our conditions.

In addition to the radial A. C. distribution system, we have a low voltage A. C. network in the downtown district. This supplies service to the customer at 120/208 volts, and it is supplied from a series of what are known as network transformers.

These are in turn supplied from a 13,800 volt sub-transmission system.

At the present time I should like to place more emphasis on the radial system. In the St. Louis district we have, as previously described, supplied our distribution sub-stations by means of 33,000 volt and 13,000 volt underground cable, and in a great part of the city we still are able to retain the distribution on the low voltage side as an overhead system. We removed 5 miles of this system every year, and replace it
6245 with underground supply. It is appreciated that this type of system is adapted to what is known as the radial system. The other systems have a feature of using a large number

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of small sub-stations, and a radial system uses a smaller number of larger sub-stations.

The result is that the radial system economizes on the cost or investment in the supply facilities of the sub-transmission feeders.

In St. Louis these facilities represent the most expensive part of the system and therefore, to economize on the supply
6246 facilities is a little better for us than to reduce the cost of the low voltage distribution, which is already less expensive.

That is not true in all areas, or in all cities. The 9 sub-stations supply the 120/240 volt direct current system, which covers 1.15 square miles in downtown St. Louis. This is not what apparently might be regarded as an error in the area, which I previously stated as .4 square miles. The downtown D. C. district extends beyond the particular area to which I referred as an extremely dense area.

In these 9 sub-stations there are 19 motor generators totalling 27,800 kw. and 10 synchronous converters, totalling 21,400 kw.

I have previously described the extreme reliability with which this service is supplied, coming from both the 25 and the 60 cycle systems, each being independent of the other. The result of this high degree of reliability permitted us to do away with storage batteries in 1925, and maintain the same degree of reliability on our Edison system that certain

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other companies were obtaining with the addition of storage batteries. They were the most expensive single part of the operation of the Edison system, and it has always been our 6248
belief that had storage batteries been eliminated in general throughout the country in the early days, and had more automatic equipment been installed on these Edison sub-stations, that the attitude throughout the country on the Edison systems might have been different.

We do not regard it ourselves as being a particularly expensive system to operate. We are not extending it, but we feel that it has a high degree of reliability, and that it is probably equal to the best grade of service that can ever be rendered by any other system.

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The new A. C. current network which is being installed and rapidly extended is the nearest prototype to the Edison three-wire system which can be produced with an A. C. system. It should give equally reliable service.

I would like to point out here that we obtained the benefit, through these years, of pioneering work done in the development of fully automatic sub-stations, and the public has obtained the economy of the—in the elimination of these huge batteries over many years, because of the successful

operation of the automotized sub-stations. The longer we stuck strictly to manual operation, we could not do these things quickly enough to maintain the service. The storage

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battery was a necessity.

The total capacity in the D. C. equipment is 49,200 kw., 23,444 being supplied from the 25 cycle system. You will notice there what a nice balance that is, 50 per cent. roughly being supplied for each system, and by overload and a little
6251 excessive loading of cables, if we lost one whole system, either 25 or 60 cycles, we would deliver reasonably satisfactory service in the downtown area. That is a high degree of reserve.

Service on the new 120/208 volt, low voltage, A. C. network, was inaugurated on May 20, 1939. This network now covers the entire D. C. district, but it is not yet fully loaded, nor anywhere near it. It is an unfortunate situation that to put in a thoroughly reliable A. C. network requires that it must practically be put in all at one time, and that all 6 of the supply feeders be provided in the beginning. There have been
6252 some sporadic attempts in various locations to economize on the installation of a A. C. network, and put in only part of it at a time, hoping to go into the rest. The results were not very happy. In other words, the fundamental basic principle of the A. C. network is that these network transformers located in the vaults, of which mention has previously been made, shall be supplied from at least three pairs of circuits, so that the loss of even any one or two of them will have no effect on the service, and the loss of the whole network vault will not affect the service.

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An illustration could be made in this way. Network transformers are designed to have at least a 50 per cent. overload rating, and also a very high short-time rating. If we wanted to supply 3,000 kilowatts of very essential service—I am describing now a type of service where you want to get the best there is—the two installations which are exactly equivalent and done in the same manner are the Radio City installations, which everyone in the country has heard of, and one which so many have not heard of, but which is a complete and duplicate arrangement, located in St. Louis, being in- 6254
stalled this summer for a very large department store, an air-conditioning installation.

There we want to have 3,000 kilowatt service for that building, which cannot be interrupted for any one of almost any number of reasons. The result is that if we were to lose one of those four 1,000 kilowatt transformers, which are installed, we could still supply the 3,000 kw. service. If we were to lose two of those transformers, the other two would be operated at overload until the others were repaired, and we would still supply 3,000 kw. of service. If we lost one of the main feeders from the main power plant, we could lose 6255
one transformer and still supply the service, and similarly if we lost two, we could still supply it.

Not only that, but those transformers are connected to

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the customers' service, and also to our street mains, so if we lost a little more than that, we probably could make it up from our other network stations located at the corners of the block, or conversely, if the customer has no peak load on at the time, and has lost no equipment, we have the bene-

fit of at least 50 per cent. of that installation for other customers up and down the street.

This type of service is what is known as service designed for a second contingency outage. Most service can stand one type of outage, but it is in difficulty when the second occurs. Now, the efficiency with which this equipment is being used under those conditions may be expressed as 75 per cent., in other words, we have only 4,000 kilowatts of transformers and cable facilities, and we are able to carry
6257 three-quarters of that as effective firm load, and sustain it through a second contingency outage.

Naturally, that type of service costs a little more than a lower grade of service, but it is what builds the business and the good will.

The growth on that network system is taking place so rapidly that I understand that 1,000 kilowatts or so has been added since I got these notes some two weeks ago, when I made this tabulation, and the installations this summer were anticipated to be 10,000 kilowatts. I don't believe they all came on, but I believe they will all be on by next spring.
6258

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Q. What is the function of the network system, is it to pick up the additional network load growth in the downtown system? A. It is expected to ultimately supersede the older systems of all types, and we hope that if you were to look many years into the future, you would see one simplified system of an A. C. network handling all loads in the area, and the elimination of all other systems in that particular area. We don't care which system we use, we want to use the one which supplies the service the best, and that

system will be determined by the load density in the area. What we hope to do, insofar as possible, is to not duplicate the system, we want one, but not two, because each system that overlaps the other in the same area, saps the load and divides it between two systems; whereas, if only one were available, your overall efficiency on your investment would be greater, and we are making every effort to follow that principle; but in our four kv. radial distribution systems, we carry all the loads in that area on that system, and would not hesitate to pick up a relatively large industrial load. 6260
On this 120/208 volt network, we are not hesitating to pick up a 3,000 kw. customer, the point being that if we can do the whole thing in a given area, with one system, we will give better service, and greater reliability at lower cost, than if we let it overlap into two or three. So that even in the D. C. district we can not avoid building some of this A. C.

—2,684—

stuff into the same area in order to pick up the load growth, but the ultimate plan is to eliminate any duplication.

That new A. C. network system we have just installed is 6261
the very last word in the United States on that class of equipment, there is no better. It ought to be, because it has just been installed. We studied the various systems throughout the country for several years, anticipating this installation, because it will be the major investment for the whole company at some time, and to get started right is extremely important.

We thought we might go into it three or four years ago, but we studied it carefully and decided that there was no merit in doing so. The fact that that conclusion was correct

has been demonstrated because since that time there have been several changes of opinion in the country as to what the final A. C. network voltage and type was to be. Some thought it would be a 5-wire system; others thought it would be 2-phase, and all of those installations are available around the country, but there are now in the neighborhood of five or six hundred thousand kilowatts of total load in the United States on network systems at this voltage, and that is so preponderant that there is no longer any possibility that
6263 some other voltage may become the ultimate future standard, and we feel entirely safe in adopting it.

To get our system in the best possible condition to make

—2,685—

the most use out of this new A. C. network, we made a study of the lamp ultilization voltages on our system, and compared that information with the use of such utilization voltages on other systems of the North American Company, and as a result we decided to raise our voltage about 2½ volts and adopt what is known as the 120-volt lamp; whereas, for many years we had used the 115 volt standard. That
6264 change, we feel, is highly beneficial, and the change was made without anyone observing it or causing any inconvenience. It results in this, that we can use the same lamp downtown on 120/208 volts system, with perfect satisfaction, that we use out in the radial system. The 115 volt lamp would not have been so good. And we thereby avoiding have two different lamp standards on the same system. That in itself is worth a great deal, not only to us, but to our customers.

Q. Returning to the distribution sub-stations, will you state the general character of construction employed? A. The

distribution sub-stations are so different in size that one cannot describe one type of construction. I can say that the stations run from 100 kilowatts, and that may be a little pole type station, mounted on a steel structure, on a pole out in a country district, with its own automatic regulation --up to a station of, say, 42,500 kilowatts, which represents the latest type of equipment, mounted in a modern brick building with a very nice external appearance.

—2,686—

In this connection, the architect who furnished the appearance engineering for that building, got the highest award at a recent exhibition of architectural photographs in some salon, carried on last year in New York, and he showed me the picture with pride. 6266

That is our new Carondelet sub-station, and a very beautiful building.

The larger sub-stations are fully equipped with oil switches, fuses, and the usual paraphernalia that goes with those things, and operate on an automatic reclosing cycle. By that I mean the oil switch, in case the feeder gets into trouble, will open the circuit, reclose immediately—if it is 6267
still in trouble it will reclose again, and try that three times, and if some trouble still persists, it will lock it out and ring an alarm.

The record is that the average trouble record here for the last several years has been a half a case of trouble per feeder per year, or one case of trouble per feeder every two years, 80 per cent. of which reclosed automatically, and resulted in merely a flicker. If you were to double that grade of service, you couldn't tell the difference, it is that

near perfect, in other words, one flicker every two years on a feeder for 80 per cent. of all of them.

Fellows have wanted to sell me some equipment to improve that service, and I told them that I just didn't see how I could justify it. It probably will be improved some day, but that is pretty good.

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Now, in these city sub-stations we were confronted, as all
others have been, with the increasing cost of oil switch
6269 equipment, and while some engineers gave consideration
to elimination of switches and using reclosing and repeating
fuses, to reduce the cost, we looked into that a little, and
we decided that the solution of the problem, because we
do want to deliver this service at a reasonable cost, was
to use the best equipment we could get, but to load it to its
capacity. In other words, an analysis of these various sys-
tems showed that many of these circuits are only loaded to
possibly a fraction of their actual capability, and if we
could keep the equipment going at its rated load, we could
keep our unit cost per kilowatt down. With that in mind
6270 we found that certain of our metropolitan sub-stations had
a sufficiently limited area of distribution that all feeders
either were or could be made of approximately the same
length. That meant that we didn't have to have such a
high degree of regulation, of regulating control, such as
10 per cent. up above or below the standard voltage. We
could do with 5 per cent. above or below in these automatic
inductions regulators.

The result was that those regulators, which are constructed as 250 amperes, when operated at 10 per cent., or 500 amperes when operated at 5 per cent. regulation, were

reconnected and re-rated from 250 amperes to 500, and supplied entirely adequate regulation.

—2,688—

The switches could already handle that load. So by that simple method we doubled the capacity effectively of several of the downtown stations, and all we had to do was watch that any long feeder be eliminated and connected to some other sub-station. All of these feeders, I should say, are carried out and terminated at the end of a feeder from some other station, so that in the event of any trouble, this one 6272
can be opened up and supplied from some other station. That is in general, a brief description.

The 13 A. C. sub-stations in St. Louis supply 124 4,500 volt 3-phase, 4-wire feeders, 112 of which have induction voltage regulation. The remainder are industrial feeders and the customers do not care for the regulation and get a slight discount for unregulated service.

The area covered within the city is 62 square miles, and the location of the sub-stations is based on an economic study of the location of loads, using a sort of center of gravity method of calculation and we try to determine which one 6273
should be installed next.

We have almost obtained a complement within the city limits, I believe two more is all we will ever need, and then those will have to gradually increase in capacity, but we will have as many as the area requires.

Of these 124 4,500 volt feeders, 106 of them have single phase induction regulators, and 6, located at what we call our Kingsbury sub-station have the regulated bus. By that

—2,689—

I mean, we have a very large device which regulates a bus

off of which a number of feeders are taken as a group. That again is a relatively recent change on our part, as a matter of economy, and no reduction in the grade of service is involved. It simply means, as the load area is developed and new buildings are built, and the density gradually builds up, at the present time we might have sub-station A here, a space, and another sub-station which I will call C here. The intervening sub-station has not yet been built because it wasn't needed.

6275 After all of those sub-stations are in place, when this B sub-station is installed, these feeders which went from A to C will be cut in two, and with half the length and half the load, you can get about four times as good regulation. Finally you get to the area for which this sub-station was really ultimately designed. At that time you can convert the station to what is known as bus regulation, regulate the whole bus up and down together, take these regulators off and move them to a new station, and start the process all over again. By that method we avoid the unnecessary purchase of large numbers of feeder regulators.

6276 You must keep in mind, though, that that couldn't be done in the beginning, because in the beginning you have to supply both long and short feeders, as they go into the different areas.

That is a rather brief and sketchy description, but it

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gives you an idea of the extent of this system.

The Examiner: Let us recess until two o'clock.

(Whereupon, at 12:35 o'clock p. m. a recess was taken until 2 o'clock p. m. of the same day.)

—2,691—

AFTERNOON SESSION.

(Whereupon, at 2:00 o'clock p. m., the hearing reconvened.)

The Examiner: Let us resume, gentlemen. Are you ready?

Mr. Hamilton: Yes, sir.

The Examiner: Go ahead.

Whereupon, STANLEY STOKES resumed the stand and tes- 6278
tified further as follows:

Direct Examination by Mr. Hamilton (Continued):

Q. Please continue, Mr. Stokes. A. The 4,000 volt distribution sub-station feeders are, as a general rule and with very few exceptions, operated as single-phase feeders.

I should explain that a little more and state that this is usually referred to as a four-wire system in which the voltage is approximately 2,400 volts between the fourth wire or neutral and any one of the other three wires referred to as
phase wires. 6279

This type of feeder starts out from the sub-station with four wires and at various points along the feeders the neutral —that is, the fourth wire—and one of the phase wires, is taken off and goes down some other street and is called a branch.

The two wires so tapped off of the four-wire circuit are

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called a single-phase circuit and that is the one that is used to supply the residents.

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These various single-phase circuits are distributed around on the various phase wires so that the load at the sub-station is properly balanced on all three wires—the fourth wire under perfectly balanced load would not carry any current, although in a large part of the country these circuits are switched, all four wires or at least all three wires with a single oil switch.

In St. Louis, and, I believe, one or two other cities of the North American group of properties, the switching is car-
6281 ried out as a single-phase operation.

In other words, we provide a separate switch for each of the three wires. By switching in this manner, we interrupt only one-third of the service which would have been interrupted had we opened all three wires, because the service difficulty is, in almost all cases, confined to one or the other of the wires and rarely involves all three.

By this method of switching, we improve the grade of service over that which could otherwise have been rendered with a material reduction in any possible service outages. I think that is clear. And that the switching of one wire out
6282 of three should result in a material improvement in the services.

Where industrial feeders are supplying current where a large percentage of three-phased motors is involved, those feeders are called three-phase feeders and we switch them all

—2,693—

as a unit.

There have been many developments from time to time that have proved very useful. One, which was first applied, as far as I know, on our own system, was the use of a ground

relay connected between the base of the regulator and the ground.

We were surprised, a few years ago, to learn that the number of regulator fires had been very low on our system compared with some other systems, and, in trying to determine why we were a little more successful, we found that this ground relay which we had used for a number of years, had operated in several instances.

Any one of those instances could have produced a regulator explosion and corresponding fire. Such fires are always 6284
very serious and result in a loss, not only of property, but frequently of life.

There has been a serious case of that kind within the country within the past year and a half.

In conclusion of this particular discussion on distribution sub-stations, I should point out that our general method is to start a sub-station in a new area with two transformers, each terminating two cables from the power plant, each cable coming from a separate bus section in the power plant, so that the failure of a bus section or the failure of a cable will not affect the service to the other transformer at the sub- 6285
station.

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These transformers are parallel on the low side and the switching and service from there on has been described.

On the high voltage side, which affects the supply cables, these are 33,000 volt. We then tap one of those cables and carry it to another sub-station.

For example, if we had two transformer stations, we would have three cables. In other words, we always provide each station with one cable which has no taps on it and one

cable which has one and later two. We do not exceed that.

In that way we have made an economy in the use of our supply cables and in no case, over many years operation, have we ever failed to have the adequate amount of supply. That is based on the theory and probability that a certain number of things would have to occur at the same time and we have, between these various sub-stations, a certain amount of low voltage tie capacity—that is, by tying the low voltage feeders together, a certain amount of load can be supplied
6287 from one station to another and even if we have 50 per cent. or 75 per cent. overload on one transformer during a case of trouble, that will not damage it in the length of time that it takes us to redistribute the load and pick it up from the surrounding sub-stations.

The result is that we attempt in that manner to produce the greatest economy and supply the system without affecting the reliability of the service.

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In the operation of these stations, I should mention there, as part of the description, that we do have to carry out a
6288 thorough system of inspection and testing at all times and insure that all the equipment is in satisfactory operating condition.

Q. Now, how frequently are these inspections conducted? A. Well, it depends on the nature of the sub-station and on the type of service.

For example, in the automatic D. C. stations, the manager is in there some time during the day. He doesn't stay long but he goes over a routine.

We learned that by experience. In the early days of automatic sub-station operation, it was thought that the

automatic equipment should take care of itself and that very infrequent inspection would be all that was required.

Well, that is more or less the case; you can get by that way; but experience has taught us that it is better to make a quick, brief inspection of the fundamentals in that station daily, that one man can cover all of the stations on the system and do that and that by so doing we simply prevent accumulation of a number of minor items which, in the final analysis, may combine to cause the difficulty, so that the automatic stations are checked up in various ways. 6290

For example, we obviously have to keep them clean so that the janitor and helper is in there at very frequent intervals.

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He is an old, experienced employee and would observe anything of particular irregularity, such as overheating equipment or smoke.

During the day there is always a man that comes in on a meter reading, removing and replacing some charts. He is instructed to observe certain things and at least once a week a complete check-over is made in the automatic D. C. stations, so that there are not very long intervals in which 6291 nobody is in the sub-station, but the total man-hours of operators in any one station are not very great.

Q. Are your distribution sub-stations of adequate capacity for present loads and for presently anticipated loads? A. I haven't available the exact statistics on the per cent. loading on all of these stations other than those that I have given previously, but, in general, they are entirely adequate and are kept so.

The way this is done is that the annual peak load is taken off of each station for the preceding twelve months and com-

pared with the previous year. We observe the rate of increase of both kilowatts and k. v. a.; as a result of those comparisons, we provide in the annual budget for additions or transfer of load, as the case may be, so that the same reserve factor will apply the following year.

In that way, we never allow the load to increase beyond a specified amount.

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This type of operation requires continuous care and must
6293 be kept up because the use of total average load statistics is not sufficient.

The system load can, for example, be constant and yet one sub-station might, for some reason, have an increasing load that year and another one might have decreased due to some peculiarity and it would not be observed in the total.

So you have to observe the variations of load in each of the sub-station areas.

Q. What contribution has the Union Electric Group made to the field of operation of distribution sub-stations? A. The Union Electric group was one of the early operators
6294 of any automatic equipment of this type and, I believe, the most extensive operator in the earlier years.

Naturally, as one pioneers the use of equipment, the pioneers make some improvements and, in our case, it was essential to do so.

We did develop a number of applications. I can mention several. One, the method of operating two or more automatic direct current machines in parallel on the same direct current bus using an automatic load-shifting scheme to make each machine assume its proper share of the total load.

This is not a particularly elaborate device, but it has been very effective. In the ordinary arrangement there is what is known as an equalizer bus. This little scheme was an

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adaptation of automatic control to insure that the load was divided as required.

Two, we were one of the first people to use bi-metallic element thermostats to protect machines and transformers against overheating.

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Those thermostats and devices were manufactured in our own utility shop and at least one or two of them were later incorporated into commercial devices which, I believe, ultimately became the Minneapolis Regulator control thermostats, but I think the first application of one of these was on one of our transformers.

Today, that sort of thing is standard practice.

The use of pressure wire bus in connection with automatic voltage regulation in direct current automatic substations gives better regulation at all points on the direct current system. A little more clearly explained, that means 6297
we carry a potential wire, a small wire, from different points on the system, which carries the voltage back to the substation, this particular wire not carrying any appreciable current, so that the voltage back of the station will be the voltage that exists out on the system and, with those wires, we are better informed as to the system voltage and can operate accordingly.

The newer A. C. network systems are following that original idea and providing rather elaborate intelligence transmission circuits to give information not only as to voltage,

but heating or overheating the transformers and many other
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bits of information that it is desired to have.

Another item was to use automatically operated dampers to cut off the air supply in case of transformer fires or fires on rotary converters.

You see, when you operate attendant sub-stations in which you had men operating, if a fire started in the building, why, you knew that the man had sense enough to either try
6299 to put it out or report it.

Well, the thing was first brought to our attention with a small fire in an automatic station and nobody said anything about it. By the time we got down there, the machine was pretty well damaged, so we incorporated devices to send out an alarm to the main office but, from the experience we had, we realized that that was not enough and at the same time, this device cuts off the air to the machine by automatically closing dampers.

At the same time it takes the machine off and clears it from the circuit. This eliminates the chance for the fire to
6300 gain much headway until someone can get there.

Also, they have CO_2, carbon dioxide, equipment, which will automatically operate to put out fires.

The CO_2 equipment is not our development, nor contribution. Our contribution was the use of the automatically controlled damper. That was quite valuable.

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Another item, use of vacuum tube-voltage regulators to control automatic rotaries and motor generators on the direct current system. Although we did not invent the idea, nor the

equipment for automatically reclosing an oil switch on outgoing feeders, we were one of the earlier users of large quantities of these switches and found them to be very inaccurate in their operation and undependable.

We were able to improve the reclosing equipment. This was applied successfully to the South Broadway Sub-station as early as 1920.

Q. Are they effective now? A. Oh, yes. Yes, I mean, the people are using those things now without knowing where
they are getting them. They are regularly applied on equip- 6302
ment today by manufacturers, but when you are the early user of these equipments you have to do it yourself and when you do, you contribute something to the art.

In the electrical industry as a whole, I refer to the utility industry primarily, there is a great freedom of interchange of ideas, facilities and information. By that I mean that the utility industry has never attempted, to much extent, to patent and tie up such ideas; particularly among the members of our North American group we interchange such ideas quickly.

If we develop these things, we tell the others about it the 6303
very first time we have any kind of a meeting or get-together.

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If there is anything that is any good, we use it. If it turns out to be no good, we all quit it.

Another development was the adoption of steel barrier walls, an isolated phase arrangement for automatic steel distribution stations, as early as 1925. I was responsible for the design of that particular station and, at the time, it was thought by most engineers and operators that steel would

in some way cause a great deal more trouble, when arcs were started, than concrete which had been used almost universally for bus structures.

We put in this station and had no opportunity to find out for a couple of years whether there was any operating advantage. We knew that there was a major construction advantage and that we would have a better job.

Finally, one day, the manager of this particular property —it happened to be Alton—decided that he would make some
6305 changes in the station arrangement, and in order to be ultra-careful, he moved into the station an external oil switch, set it up, connected it up and made connections preparatory to transferring the circuits through this switch so that he could be doubly sure that nothing would happen.

He had an extra source with which to clear the circuit. He then took his last lead, put it on an insulated stick—what is known as the Johnson Clamp—and clamped it on to the bus. After having gone to all that trouble, he made one rather fundamental error—he forgot to open the oil

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6306 switch and when he clamped that thing on, he had a dead short.

Fortunately, he was far enough away from it that it didn't get him and after it cleared, the situation showed that the steel barriers, which had a hole burned in them about an inch and a half in diameter, had withstood the arc and the repair of that was a very simple matter with an ordinary welding torch and the man's life was probably saved, because, had that been concrete, he could not have gotten a complete contact. The arc would have played around quite

a bit, would have flared out and, no doubt, gotten him, because we have had other cases in a matter of such type.

So we were convinced that the steel barrier was satisfactory.

The various companies have adopted that since and we are very favorably inclined toward it, even for major powerplant installations. Several North American properties are using it to advantage.

I have one or two other items which I had intended to
mention. 6308

Another item. We helped develop, as well as install, recording devices in automatic closing timers. A timer is a device which determines the interval of delay in a reclosing automatic circuit breaker.

In other words, whether it should reclose immediately or

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wait a few cycles or how it operates. It is controlled by what is called a timer.

In order to obtain a record of what actually took place, we developed a little automatic device to be incorporated in
these timers. 6309

It is interesting, when difficulties are cleared, to know what took place, because you learn thereby and can avoid it the next time, and it is impracticable to employ such devices as these automatic oscillographs which we have mentioned where you have such a large number of applications.

Another point, which is not a matter of development of apparatus or pioneering, but a device to adopt a certain practice—in other words, we rather early adopted the reclosing cycle for 4,500 volt circuits at a time when it was generally regarded as more or less impracticable.

We said, "Why wait so long? Why not close them right in and restore the service in most cases?" And the same type of reasoning is being applied now to higher voltage circuits. That is, today, very common.

We set up a test circuit and ran it for some months and found that no damage occurred and that we did improve the service and the device was made to do it on all of the feeders. The use of 33,000 volt cable connecting the transformer at the source with the receiving transformer with no high
6311 voltage switches was adopted many years ago by our company as more or less standard practice.

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We have, to date, found no reason for changing our view. It has a very good feature in its elimination of high short circuits as well as the reduction of high voltage equipment. Any simplification of equipment should result and does in obtaining better service.

Some years ago, there was quite an investigation made by the American Telephone & Telegraph Company as to the major short circuits that had occurred in different cities in
6312 the country and the Commission was sent to St. Louis to investigate us for the simple reason that no complaints had been had by the Telephone Company as a result of high short circuits in our district.

Q. Sent by whom? A. By the American Telephone & Telegraph Company.

The reason for this investigation was that somewhere, I believe, near Chicago, there had been a heavy short circuit in a cable which induced a high potential in a wire leading to the telephone exchange.

This caused a flash-over in the telephone equipment and which, in itself, would not have been particularly serious, but it frightened the girls and they all ran for the stairway and there were some girls either injured or killed and the telephone company wanted to avoid any possibility of such a recurrence.

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The conclusion that they reached, after having been at St. Louis only a few hours, was that there was no reason why we should have any high short circuits the way our 6314
system was designed and that the explanation was obvious, that we did not tie together a great quantity of equipment and subject all of it to the full capacity of the plants.

This, to some extent, at least, in my opinion, was an additional justification for our methods coming from an independent source.

(Discussion off the record.)

A. (Continuing) Another item of pioneering application was the use of an automatic transfer, 138,000 volt sub-station unattended, fully automatic, including 33,000 volt 6315
automatically regulated bus, and a number of outgoing feeders.

The application of this station, which was installed about two years ago, included a number of original features. I, personally, am not aware of any other station of just this character at that voltage operating fully automatic.

The service obtained from this fully automatic station does supply the outgoing lines with a continuity that could not be obtained by an operator if he were there, because it

requires a selection and changing in the time of operating switches in a period of less than eight cycles.

That is, in other words, this station has to select between two ways of operating the switch and do it in less than

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eight-sixtieths of a second or it can cause difficulty. No operator could do these things if he were there; he would have to depend on the equipment.

One other item was the use of a directional distance
6317 relay for ground fault protection. That, we believe, we were the first to apply on a major system and it required many modifications before it was fully effective.

This relay, in conjunction with some other similar devices, really represents the brains of this automatic station that I have been describing.

Q. And you have already referred, have you not, to the use of ground relays on regulator frames as a means of reducing fire hazards? A. I did refer to that. It is one of those cases where I am not able to show a positive proof
6318 of the extent to which it is valuable, but the negative proof indicates a situation that if we have, in the operation of that device, as much as, say, four or five times—if any one of those five times had functioned the same way, without the device in the regularly stated service—the particular kind of regulator to which I refer was known to be subject to explosion under the conditions in which it was used.

If any one of those occasions has saved a regulator explosion, the device was a real contribution.

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Q. I think you have already mentioned, briefly, the proposed change over at Fort Madison, Iowa, from 25 cycles to 60-cycle power. You might just comment on that very briefly, if you will, at this stage. A. 25-cycle service is not as satisfactory for lighting as 60-cycle service, and as I have previously explained practically all of our 25-cycle service is used for industrial applications or street-railway load where lighting, itself, is not involved.

There are one or two relatively small towns in Iowa,
which got service in the early years at the time the dam was 6320
constructed, which have the 25-cycle used for general distribution. We are now proceeding to eliminate that and convert it to 60 cycle without any expense to the community.

Q. Now, does this result in better service? A. It results in materially better service to that community but involves some very important expenditures on our part. I would like to describe that situation. We had to put in a 6,000 k. v. a. sub-station, frequency-changer job, rebuild a small plant at a cost of about $152,000 but in addition all of these customers had an abundant supply of appliances which
would not operate at 60 cycles. 6321

After having used the greatest care in trying to convert some of the equipment to 60-cycle operation, having made a survey of all of the equipment, we still had something over $200,000 worth in just one small town which we had to furnish. There was no one else to do it. Since it is property

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that we aren't going to own, you have to look on it almost as a gift to the customer. I don't see how you can regard it any other way, but it is one of the essential features of

such a change-over. The company undertook that obligation.

The city of Fort Madison, itself, is having its distribution system completely redesigned and the transformer connection and such other changes made as are necessary to provide 60-cycle service in place of 25 cycle.

Q. Turning now to the distribution system, itself, I think you have given previously an overall statement of the number of customers served by the Union Electric group. Are you able to classify those customers in general by the county
6323 in which they are located in order to indicate the density of service in a particular county? A. The particular date as of which I have this information is December 31, 1939. The total number of customers as of that date is 349,096, distributed geographically as follows: City of St. Louis, 202,308; St. Louis County, Missouri, 74,674; St. Charles County, Missouri, 3,633; Franklin County, Missouri, 4,773; Jefferson County, Missouri, 7,794; St. Francois County, Missouri, 5,254; Lakeside Division, Missouri, 286.

Q. Now, that Lakeside Division you just referred to, is that the territory around the Osage plant? A. That is the
6324 territory immediately adjacent to the hydro-electric plant

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and the Lake of the Ozarks. That was just a natural outgrowth of the construction of the dam; the residents in the vicinity wanted to obtain electric service and we supplied it.

East St. Louis and Alton Divisions, 39,090; Keokuk Division, 11,284, which totals to the previous figure.

Q. I think you have previously given the distribution of customers by classifications of service, but I don't think you have stated the amount of kilowatt hours taken by the

respective classifications. Are you able to state the number of kilowatt hours so taken by various classifications within your own rate schedules? A. I can subdivide that to about 6 or 8 classifications. The annual sale of kilowatt hours, based on the year ending December 31, 1939 is: residential classification, 309,987,615; commercial classification, 237,-653,585; street lighting, 34,102,442. The combined total for those three classifications is 581,743,642.

Other public authorities, 13,548,642; other electric utilities, 401,412,412; railways, that is the street-railway load, 6326
123,506,900; combined total for that group, 538,406,954.

Large industrial classification, 1,020,297,591. The combined total for all classes for the year 1939 is 2,140,509,187.

We are having a very rapid increase in kilowatt-hour generation this year and I believe that that 2,100,000,000 figure has already gone, I think, even beyond 2½ billion at

—2,710—

the rate it is going. If we compare that with the year 1919, at that time, 20 years ago, we had 353,185,617, and in the year 1919 we had 112,484 customers compared with the previous figure of 349,096 for 1939. 6327

Q. At what voltages is electric energy distributed by the group? A. The general lighting service in all areas is distributed to the customer at 120/240 volts. By that we mean that where you have three-wire service the potential between the two outside wires is 240 volts and the potential from either outside wire to the middle or neutral wire is 120 volts.

The larger-sized motors are operated on the 240 volts and the lighting is always on the 120 volts. A small customer will obtain only two-wire service, which gives him 120 volts.

Now, in the alternating current, secondary network for the high density city service, the voltage is, single phase, 120 volts and, three-phase, 208 volts. Power service in practically all areas is either 240 or 480-volt, 3-phase voltage.

Industrial-power service is delivered at the primary side of the distribution transformer at 4,160, 13,800, 33,000 volts, 60 cycles or 13,200 volts, 25 cycles depending on the particular district in which the service is rendered. That means that the customer has the meter on the high voltage
6329 side of the transformer and distributes his own feeders in the factory or wherever he wants to and does his own transformation. —2,711—

Q. And the street-railway load is at what voltage? A. It is practically uniformly supplied at 13,800 volts, 25 cycles.

Q. Your statistics on sales kilowatt hours indicate a fairly substantial street-lighting load. Can you comment on the extent of the street-lighting distribution? A. The largest user of street lights, the city of St. Louis, owns and operates its own street-lighting system and purchases power from the Union Electric group. This power supplies some 50,300 street
6330 lamps in streets, parks and public places, such as bridges and alleys, all of the power coming from the Union Electric group. The lights and equipment on the municipal bridge, a number of alley-lighting systems and a few private systems in the city are owned and operated completely by the Union Electric group. Outside of the city limits, that is in St. Louis County and various other locations, the Union Electric group owns and operates the street lights, themselves.

The city of Kirkwood, which is a municipality, owns and operates its own street-lighting system and purchases the

 6331

power from the Union Electric group. Clayton, Missouri and Washington, Missouri each own a few lights in their business district and all are supplied from the Power Company System.

Q. By that you mean by the Union Electric group? A. By the Union Electric group.

—2,712—

In the street-lighting equipment, which is owned and operated by the Union Electric group, there are a total of 65 6332
circuits serving over 6,189 lamps, 1,941 of which are ornamental standards supplied from underground cables. The remaining 4,248 are overhead fixtures supplying aerial circuits. This latter group is about equally divided between bracket-type fixtures and center suspension.

Most of these circuits are supplied from 6.6 ampere, constant current, street-lighting regulators. Although there are some variations in some cases, the larger lamps are handled from 20-ampere transformers in the ornamental pole, itself.

Very few of these operations are carried on with the multiple circuits, only in some remote districts where no street- 6333
lighting circuit was available.

15 of the 65 circuits are controlled by time switches in the various suburban distribution stations, the remaining 50 originate from series regulators installed along the distribution feeder. These are automatically controlled by time switches, the more recent of them using a separate relay and an oil switch, mounted at different locations from the relay.

(Discussion off the record.)

The Witness: The street-lighting circuit, as a rule, causes very little trouble; most of these circuits are equipped with sectionalizing devices. If any trouble or anything happens to the loop, that loop of the circuit is cut out and the rest of it goes on, and it is very

—2,713—

simple to operate and leads to very little difficulty. The service on the street-lighting circuits, as they are designed and maintained today, is very reliable.

6335 Of course, it involves a constant maintenance and cleaning schedule to keep the equipment and the lights in good order. There are, also, some street lights in East St. Louis and Alton, Illinois which are maintained and served by the Union Electric group.

A few of the Whiteway Systems, including 479 standards owned by the cities, are operated on energy purchased from this same Union Electric group. In Keokuk and other Iowa communities there are about 1,530 lamps owned and operated by the Union Electric group. That is about all of the street-lighting equip-

6336 ment.

By Mr. Hamilton:

Q. What type of distribution is employed in the distribution system? A. The distribution system, as previously described, is a 2,300/4,000 volt four-wire radial-type system which, as a rule, is regulated by induction feeder regulators at the sub-station. The urban-type feeders, those in and around the city, are all operated with the single-circuit oil switches as previously described. The rural circuits do not all have the automatic reclosing feature.

In connection with the city and urban-type feeders, St.
—2,714—
Louis is outstanding in its use of heavy conductors; that is, the standard conductors that we have the greatest mileage in are the 4/0 size, whereas some cities depend on a 2/0 as a general rule.

We have done some experimental work in using a 750,000 cm. feeder for the very heavy distribution and are not convinced as yet as to whether it is practicable or not, but we have a number of 500,000 circular mill feeders operating 6338
successfully. This large-sized conductor is only feasible in the areas where the load is quite dense. There is no fundamental difference in design in the suburban-type feeders as distinguished from the city feeders except that the conductor is usually the smaller size. This same comment would apply to rural feeders, but in their case they usually have some form of fuse, frequently an automatic-repeater type and the feeder, itself, is of lighter wire.

Urban and suburban feeders are all closely physically interconnected so that the loss of one feeder can be picked up by adjacent ones. The design of such a system has to con- 6339
template that practice and we have a regular practice of providing from 1/4 to 1/3 excess capacity in these feeders so that two or three feeders can always pick up the load of one more. It is equivalent to providing a reserve circuit for not over 3 feeders as a rule and always one reserve circuit for four.

This distribution system has had a rapid increase in its
—2,715—
size. Since 1919 to 1939 there has been a very large percentage increase in a 20-year period. I should like to de-

scribe that with respect to several classifications: Poles, December 31, 1919, there were 41,958 which by 1939 had become 147,116; Miles of distribution wire in 1919 was 8,379, this has increased to 29,757; Single conduit in miles, 810 had increased to 1,306—the conduit, itself, may have more than one duct but in this case I am giving it per duct mile; distribution cable in miles, 552 and 886. The set of the majority of this system is overhead and not underground. Meters have increased from 116,495 to 374,548.

6341 Q. Now, without going into any particular detail and since it represents a very important part of the total enterprise, could you comment briefly on the development of the distribution system to amplify the statistics which you have given? A. I believe that in previous testimony describing the general features of the company that I made some partial reference to the early activities, although I do not believe that I gave but just a mere mention.

I would like to include at this point that St. Louis was one of the oldest pioneering electric users in the country and that the Missouri-Edison Electric Company by 1898 claimed
6342 such outstanding achievements as the operation of alternating current generators parallel, use of induction-feeder regulators, distribution of power by means of an A. C. network and the operation of the world's largest A. C. arc light

—2,716—

station.

Q. Was the company to which you have just referred by name a predecessor of the present Union Electric Company? A. It was a predecessor of the present Union Electric Company of Missouri.

The early system bragged about their load factor of 20 per cent. compared with our present-day load factor of 60 and stated that in their early records that they were active in the promotion of the sale of single-phase motors, so to that extent we are still at it.

There has been a gradual change, as the years go on, as to the standards for the utilization of voltage, that is the voltage at which the lights are operated. In the early years the majority of all lamps sold were sold at from 100 to 110
volts. Then the sales gradually shifted and for many suc- 6344
ceeding years and up until the last, possibly, five, the greatest percentage of all lamps sold fell in the 115 volt class.

For the past five years much more than 50 per cent. of all lamps sold,—I think it exceeds 60 per cent. today and possibly a little more,—were sold at 120 volts regularly and this is the voltage at which both utilities and manufacturers would prefer to remain. Our system has been brought in line with this recent standard and the lamps now being sold throughout the Union Electric Company group districts are 120 volts.

This is an important item because you can't afford to have 6345

—2,717—

two or three different types of lamps being sold, because you never can tell where they are going to be used. You can't control their distribution once they leave your hands. Besides, others sell lamps in ordinary stores, consequently, if there were two lamp standards in the district there would be bound to be some of them missupplied. If there were two lamp standards such as 115 volts and 120 volts it would always cause difficulty. We have made very special effort to get our system into the condition where the voltages

delivered on the various distribution circuits are all suitable for the 120 volt-standard lamp. That lamp will operate successfully for two or three volts above that rating and three or four volts below. It will stand more voltage below than above to operate equally well. In other words, the mean voltage for which that lamp is designed is probably 118 volts.

The studies that have to be made to keep a distribution system up to date and in good condition are voluminous. You have to constantly keep at it, study the trend of the
6347 load, the rate of load growth and the load growth by areas and keep your reserve equipment at the proper percentage in all the different areas.

The purchase and installation of electrical equipment does not, of itself, guarantee good service, that is something that we have learned over many years, that you have got to constantly study it and keep it in condition and keep it adequate, keep ahead of your load.

—2,718—

If a transformer is severely overloaded for a number of years and burns up, that is not the transformer's fault, that
6348 is because somebody did not do all of these things which I have indicated and we make every effort to follow continually this type of inspection.

One of the first things you have to know is the voltage condition on your system. For many years a large number of companies depended entirely on complaints from customers, so-called voltage complaints, to determine whether or not their service was satisfactory.

I would like to relate the reason why that is not particularly a good way to do it. We checked up our voltage com-

plaints for a three-year period. We classified them by the nature of the telephone call and the Distribution Department analyzed those figures and seemed to be able to make nothing of them. They seemed to be very inconsistent. I turned the whole group of figures over to one of my assistants who is interested in frequency distribution and probability curves and such matters.

He plotted the record of these complaints in the form of what is known as the frequency curve with what was then a
rather surprising result. It was that the greatest number of 6350
complaints came at the point of rated voltage,—in other words, if 115 volts was our standard voltage that we were trying to deliver. After these complaints, you understand, we went out to measure the voltage, checked it up. The largest number of complaints came at the point where the voltage

was the best. This is easily explained if you think just a moment.

If you have 10 customers on an electric system getting 100 volts and 10 customers getting 130 volts and if all 20
of those complain, you wouldn't get anything like the num- 6351
ber of calls that you would from 350,000 customers who think that the voltage is wrong and who call up for some reason. When we get out there we usually locate the reason, but the answer is you are going to get more trouble calls because there are more people. If you have a good system and well-regulated voltage, you are going to have a very high percentage of all the customers on the system there get that voltage that they are supposed to get and if you take 350,000 customers they are going to call up about

something, usually because of some of their interior wiring or their fuses are out and something else is wrong. The management checks that, but it isn't the conclusion that you would arrive at without having checked it up.

(Discussion off the record.)

The Witness: (Continuing) But it is a fact that you can not afford any longer to use customers' calls as an indication of voltage trouble, you have to go and

6353 measure it.

By Mr. Hamilton:

Q. In order to get a comparative idea of the constant additions and changes that are being made in the distribution system, are you able to state the amount of retirements and additions that have been made to the system in a par-

—2,720—

ticular year? A. Yes, I can state the figures very closely for the year 1939. The distribution system additions were $3,700,000 and we retired $1,100,000 for the same year. The continuous development of additional load and other im-

6354 provements, particularly highway improvements caused us to spend a very considerable sum of money every year in addition to which we have an arrangement with the city whereby we remove every year five miles of overhead circuits. That should have been independent of whether we need to remove them. We do it anyway and thereby reduce the mileage of overhead lines in the city and we do not add any. The result is that in a very definite number of years all of the overhead system will have been removed from the city streets without any hardship to anyone.

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Q. You are talking about St. Louis? A. I am talking about St. Louis city.

The expenditures brought about by civic developments and other requirements amounted to $80,900 in the year 1939, and this figure, or even a larger figure, is applicable almost every year in some manner or other as our share in the civic programs.

Substantial losses are occasioned by the removal or abandonment of existing plants under some of these changes
which are particularly applicable in the last two or three 6356
years.

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For example, we have a Jefferson Memorial Project along the river front of the Mississippi River, in which many square blocks of buildings have been razed, and are to be replaced by some form of memorial. The exact plan has not yet been determined. We had to remove all of our service out of that area, and we don't know what we are going to have to put back, but our estimates indicate that our retire-
ments there are likely to run about—they could run as high 6357
as $370,000, and they won't run less than $150,000—and the additions have been variously estimated at $190,000.

Now that is merely one of these city improvement projects. There will always be certain projects of that kind going on every year, and we have to cooperate with the city and keep our service requirements up with their developments.

The Examiner: We will have a recess of five minutes.

(Whereupon, a short recess was taken, after which the hearing was resumed.)

The Examiner: Let us resume.

By Mr. Hamilton:

Q. In designing the distribution system, is it necessary to take into account the occurrence of storms and weather hazards? A. It is. The design of a distribution system—I am referring now particularly to the overhead poles and
6359 wires—does not contemplate storms of tornado proportions. It is impracticable to design for such loading, and as a

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result of much study over many years, certain standards have been agreed upon and are published in a circular issued by the Bureau of Standards, known as Bulletin No. 54.

That sets out the types of approved construction for certain areas in which the loading may be either Light, Medium, or Heavy. We are in the Heavy loading district, and carry out the same type of design for these poles, and
6360 with just as great care as we do for our major transmission towers.

The reason for that is obvious, that there are so many of the poles and wires and cross-arms that the total investment is very large, and that you can not afford to leave a big factor of ignorance in your design.

In the early days when poles were very cheap, and the best ones could be had without difficulty, it probably didn't pay so well to spend too much time in design. Some of the early systems were just built. But a little at a time, we found out exactly what poles would do, and the various

timber is tabulated, allowable stresses are all available, and we try to stay within a reasonable factor of safety for what is known as Class B, or Heavy loading.

There is an allowable variation in such design in which you can, under certain conditions, operate your conductor at higher stresses. We prefer to operate and design our conductor for what is known as 50 per cent. of the ultimate strength. This is a conservative design. We could go to 60

—2,723—

per cent. without exceeding the code. 6362

The unequal design of structures in a distribution system, does no one any good. It is a waste of money. If you have a pole that is a great deal stronger than either the cross-arm or the wire, or vice versa, you don't gain any increased effective strength out of it, and you do spend money. So the ideal system is one in which the individual structures are carefully engineered and watched. It does not require an unreasonable amount of time, and you should get a design that is consistent.

If you want a stronger pole, design for it, but keep all of the strengths in a consistent relationship to each owner. 6363

Another thing that is of great importance to an electric company is the life that you get out of these poles. That again requires that care be used in the treatment of the poles, that is, as to their impregnation. If you are using yellow pine poles, you have to be careful that you get a high-grade pole in the beginning. That means that you must have specifications on which they are purchased, should have inspectors where they are being treated, and you should see to it that the pole is what it is supposed to be.

If a properly treated pole of good quality—and by good quality I mean a tree that was not grown in a swamp where they grow so fast that there are very few rings per inch, and

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the wood has no strength—you can take a piece of fir, which has been grown in very wet soil, and it may only have 5 or 6 rings per inch, and it has all the characteristics of a Nabisco wafer. If you squeeze it in one direction it will crush, particularly if it is wet. That type of timber will not last.

6365 Now then, if you get good timber, and have it properly treated, and if your hardware is carefully selected, you get an effective life out of all proportion to a carelessly done job. That is why continuous attention and intelligent analysis pays well.

We try to do the very best job with that that we can.

The theories of operating electric companies are frequently stressed, and sometimes not enough attention is paid to keeping up and every day applying some of the theories that are enunciated. It is easy to state a theory, but it is hard work, day after day, to adhere to it.

6366 I think the latter is the one that probably has almost as much effect on the ultimate service as the spectacular things that are done occasionally.

The tornados which have visited our areas at various times have been pretty severe, but it is a fact that the service interruption, particularly in the tornado of 1927 with which I am familiar, it tore a swath right through the City

—2,725—

of St. Louis, and it blew in one end of our Venice plant and blew out the other, blew the roof off, blew the east wall,

which was a temporary metal wall, about two miles into an adjoining town, Granite City; and did a number of very peculiar things.

The operator who saw the wind coming up rapidly, ran in under a balcony and the wall fell in on the turbine, which had just been shut down, but he wasn't hurt.

Another operator heard a buzzing noise, a whirring noise,
and he thought the rotary was running away, and he ran
over to attend to that, and it was under a heavy concrete
balcony, and he wasn't hurt. 6368

The noise was due to the running away of a ventilating fan which was in the end wall, and was being driven by the wind, and it threw its blades all to pieces, and one of them cut through an oak rail about an inch thick.

The outdoor substation, which we had just completed about three weeks before that, was completely blown away. One board was driven from a lumber yard across the river half a mile, and penetrated a transformer tank.

Q. I was just going to inquire whether these calamitous
circumstances happened with any frequency? A. No, but
I wanted to illustrate what really took place with respect 6369
to service.

But with all of these factors involved, the number of

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people who were unable to obtain service, and who wanted it, were very few. Keep in mind this, that this plant was completely duplicated by others, and the loss of that Venice plant did not affect anyone.

All of our major distributions underground, and the areas on either side of this swath, knew nothing about it,

and the people within the particular area, which was about a quarter of a mile wide,—and this doesn't go continuously, it left and came back down again in two or three places—they did not require service because the buildings were destroyed or damaged, and we were able to restore the situation to normal with a very moderate loss of service.

I can say, as far as I know, that we received no complaints.

—2,727—

6371 At a time like that, the public does not complain, they understand what is going on and they compliment you on the quickness with which service is restored.

Now, of course, a tornado like that has occurred only twice in St. Louis, once in 1896, which didn't do as much damage, and one in 1927.

We have had major sleet storms, one in 1916 and another in 1924, and we had a 30-hour downpour in 1915. Those all caused more or less trouble, but that represents all of the calamitous storms of those proportions that we have been able to locate as far back as we can find any records, and the
6372 loss of service under those conditions is not severe, and we get all of our crews, accumulate any construction crews, and restore the service as quickly as possible.

In one particular case, I was building the Crystal City transmission line from Cahokia to Crystal City, and I had around 160 men on that job. There was another construction job under way, and this sleet storm of 1924 hit the city. It didn't bother the city very much, but it bothered the outlying territory more. A heavy sleet like that is a matter of 1 degree of temperature, and the city temperature was run-

ning 1 to $1\frac{1}{2}$ degrees above the surrounding territory, and the sleet didn't form heavily in the city.

We put that crew of 160 men from this transmission line job, as assistants to the regular crew, and we cleaned up that

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area there in very short order.

So that, in times of emergency we do the very best we can, and we think we do a very creditable job. Those don't occur except at very rare intervals.

Q. Your testimony so far has covered the major classifi- 6374
cations of the property of the group. In order to complete the story, however, will you indicate very briefly the nature and extent of the general purpose facilities which the Union Electric group owns and operates? A. In running a system such as that operated by the Union Electric Company of Missouri and its subsidiaries, the Union Electric group, there are required a number of other facilities not specifically engaged in handling electric current.

There are numerous general purpose structures of which the following list which I propose to read, will be an example. This classification refers to offices for general office purposes. 6375

In the City Division, we have 5 offices including a large central office building.

In the St. Louis County Division, we have 5 offices, including their main division office at Webster Groves.

In what we refer to as our outlying divisions, and that comprises the counties surrounding the City of St. Louis and St. Louis County, there are 9 offices. Those are located in

—2,729—

Franklin County, St. Charles County——

Q. (Interposing) How many officers do you have in Franklin County? A. We have four offices in Franklin County, one in St. Charles County, 2 in Jefferson County; 2 in St. Francis County; 1 in St. Charles County—the office in St. Charles County operates for the 2 companies in St. Charles both of which are direct parts of the Union Electric Company of Missouri, and the second one that I mentioned had to do with an office for the St. Charles Electric Light & Power Company, which is one of the Union Electric group.

6377 Another office is at Lakeside, Missouri, for the Lakeside Light & Power Company. That is right on the edge of the county line, I think it is on the edge of Miller County, but I can't say definitely whether Lakeside is in Miller County or just over the line. That doesn't matter and it is very close to that point.

The Union Electric Company of Illinois has three offices, one at Alton, one at East St. Louis, and one at Hartford.

The Iowa Union Electric Company, and the Mississippi River Power Company, together, have six offices located in the towns of Keokuk, Ft. Madison, and Dallas City, Iowa.

6378 Q. Now, in general, what is the nature of these offices? A. They are offices——

Q. (interposing) Are they general offices? A. General

offices at which the clerical work, billing, accounting and headquarters in the smaller divisions, as well as the points to which the foremen of the operating division would report.

In addition to such office building, we have arrangements made, either in our own offices or in buidlings owned and operated by others, whereby customers can conveniently pay their bills. There are a large number of such pay stations.

I might summarize those to indicate the extent of them. The City Division of the Union Electric group has 69 pay stations. The St. Louis County Division has 42. The outlying divisions have 36.

Q. And those points at which payment can be made are distributed, are they, throughout the territory? A. Distributed in the most convenient manner that we can devise for the benefit of the customers. There are a combined total of 158, if you will add 11 other miscellaneous offices not included in that group. 6380

Q. Now, very briefly, can you state the number of points at which trouble calls are received and repair crews dispatched? A. I have the detailed information on the places at which trouble calls can be received or dispatched, and I can summarize those.

In the City Division, they are all handled from the 12th Street office where we have quite a trouble force available at

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all hours.

Q. Is that your main office? A. That is our main office and that is where the main force is concentrated, and where we have the extensive telephone facilities and everything 6381
that is required to carry on such work.

The St. Louis County Division handles their trouble calls in a similar manner from their main office at Webster Groves.

The outlying divisions, which are scattered through these various counties, necessarily have to have available a trouble report point for each of the divisions, and that includes 9, 1 at Festus, 1 at Flat River, 1 at Washington, 1 at St.

Charles, 1 at Pacific, Bonne Terre, De Soto, Union, and St. Clair.

A similar point is located at the headquarters office in the town of St. Charles and trouble calls for Lakeside are handled at Lakeside.

The Union Electric Company of Illinois handles them from their three offices at Aiton, East St. Louis, and Hartford.

The Iowa Union Electric handles their calls at 5 points,
6383 largely at Keokuk and Ft. Madison, with a smaller quantity of calls handled at Dallas, Warsaw, and Hamilton. That is a point just across the dam, that is merely a matter of convenience.

In addition to points at which you can pay bills, and from which we dispatch our trouble men, we also have other

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types of facilities, pole yards, for example, which are a very important adjunct to an electric company, where we store all our poles and some other facilities to go with distribution, so you don't have to haul very far to get to any par-
6384 ticular point on the system.

The Union Electric Company of Missouri has 14 locations at which such storage is kept; the Union Electric Company of Illinois has two; and the Iowa Union Electric Company has five, making a total, I believe of 21.

We also have garages. Some of them are rather large, extensive garages.

The Union Electric Company of Missouri has, in the City Division, two garages, one of which has just been completed and is a very modern and up-to-date garage, not only a build-

ing, but yard and other facilities including cranes, material handling devices, and other features, in which we have a combined group of facilities to handle both transportation equipment as well as material.

Q. Just give the total figures on this, if you will? A. For the entire Union Electric group?

Q. Yes. A. There are 13 independent locations at which garages are maintained in the Union Electric Company of Missouri.

The Union Electric Company of Illinois has 3; and the 6386
Iowa Union Electric Company and the Mississippi River Power Company have 5.

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In addition, we have storerooms, some of which are located at the same points as the garages, and some of which are not, but we are rather proud of our facilities and operations. They are very modern and up-to-date in all of the equipment which is expeditiously required to handle large quantities of material.

There are, for the Union Electric Company of Missouri, 10 6387
such storerooms; for the Union Electric Company of Illinois, 5; and for the Iowa Union Electric and Mississippi River Power Company—5. In addition to that, we have a number of repair shops which total, for the entire group, 4. One of those is a very extensive and complete machine shop with all modern machine tools such as milling machines and welding and cutting equipment. We do a large part of our own repair work in the shop. We have laboratory facilities for testing at 5 locations for the Union Electric Company of Missouri; 1 for the Union Electric Company of Illinois; and

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2 for the Iowa Union Electric Company and Mississippi River Power Company combined.

These laboratories are primarily for meter testing, but along with that type of testing they do various other testing, usually electric. They test rubber gloves and they test electric ranges and test new appliances, and all forms of electric testing. We do not maintain an ordinary mechanical

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testing laboratory such as is used for cement work, and so

6389 on, as I explained previously.

Q. These all-purpose facilities are distributed rather generally, are they, throughout the territory? A. Yes, they are generally distributed, but I wouldn't want it thought from that, that they are carelessly distributed. They are in selected locations, selected with great care. You see if we can analyze the number of trips made to and from these yards, after we get several years of experience, we can indicate the possibilities of economy if the locations are changed. We have had occasion to change very few, practically none. There is only one yard that I know of that has been con-

6390 cluded to be in not the best location. This new one will take care of that.

But the location of a pole yard receives careful study and analysis as to where those poles are going to go and how much haul there will be from that point, and we try to pick them so as to produce the minimum amount of haulage and travel.

Q. The location of the pole yards may determine to some extent the speed at which a repair is made? A. It would. We do not know of course at what point repair work of

an emergency type is going to be required. Therefore, we have got to have these yards properly distributed so that no point on the system is excessively removed.

In general, however, I think the greatest economy is ob-

—2,735—

tained in the location where the normal operation, every day, of hundreds of trucks hauling this material, will not produce an excessive mileage.

The light type of trouble work is not entirely related to these pole yards. The trouble man would get to an emer- 6392
gency in a light car anyway. He would be dispatched from a garage. If the service was of some particular major importance, if there had been some severe breakage of a pole, or something like that, that pole would have to be delivered from the nearest point.

Q. Now, very briefly, if you will, the nature and extent of the transportation and construction equipment of the group? A. The transportation equipment is an extensive item in a company of this type, referring to the Electric Company of Missouri, the Union Electric Company of Missouri and the group. We have quite a fleet of construc- 6393
tion and miscellaneous equipment. About all I could do would be to summarize it, the totals, to give an understanding of the magnitude of it. There are 198 passenger cars, 240 trucks, 72 of these large industrial trailers that are operated from a tractor, 6 tractors; 2 portable cranes, and one of those is designed to lift heavy loads and was specifically designed to install and remove and maintain these network transformers which have to be let down through a grating in the sidewalk from a truck located in the street, and

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6394

you cannot afford to obstruct traffic for any length of time in a busy area. That required rather special design.

We also have concrete mixers—6; and 14 of these gasoline driven air compressors on wheels.

The aggregate cost of this equipment is considerably over $600,000.

We selected the equipment with as much care as we can, keeping in mind all the time the application for which it is intended. We do have a lot of street and paving work to do,
6395 and concrete breaking and breaking of pavement, to get into conduit lines, and economy in that work is very essential, and machinery helps materially to do it.

Q. The list which you have just given includes trouble cars, does it? A. Yes, that includes—well, I listed passenger cars, but I am not quite sure whether that figures includes trouble cars or not. The trouble cars, as used by the individual trouble men, are passenger cars. I believe that that figure should include them.

Q. Do you mean "should" or does? A. Well, I can't say for certain whether it does or not but I can look that up if it
6396 is of any importance.

Q. Now, turning to the operations of the system, will you state the base load generating plants in the system and relate

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the functions of the other plants to the operating of the base load plants? A. The answer to your question requires that I again mention the same power plants that I have previously mentioned from the standpoint of property, but with the intention now of stating something about how they operate.

The Union Electric group has this interconnected generator system consisting of the 6 plants, 4 steam and 2 hydro,

and the plant which is depended on for the higher load factor work is Cahokia, where the better equipment is available in quantity. In combination with the hydro plants, we assign to the different units in the different stations a load which they can carry most economically at the time.

The hydro plants in this system are constantly varying their output, and it requires a very close detailed attention to keep the steam plants fitted in with the requirements of the load, and at the same time utilize the hydro power inso-far as possible. 6398

The operation of such a system is much more complicated than that of a straight steam system, and is somewhat difficult to explain in a limited time.

The first situation which we encounter in attempting to set loadings is that we have to find out what is the dependable capacity for different types of service of each of these plants.

The drainage area of Osage, for example, is not the same

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as that for Keokuk. Therefore, there should be and is some 6399
diversity between these two properties. The Keokuk plant has limited storage, and that has to be kept in mind, and if there is any considerable amount of stream flow, that has to be used.

Osage has storage, but it has to be scheduled and used effectively to get the most good out of it.

The basis of our operation may be expressed by stating that as a result of many calculations and experience to date which is about 8 years, we are confident that we can safely assign, as a combination rating for Osage and Keokuk, the

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ability to carry 200,000 kilowatts of our system peak for the entire period of the winter peak.

That is, not 24 hours a day, but to cut 200,000 kilowatts off of that peak each day for as many days as required.

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The individual ratings of those plants, of course, are at various times much larger than that. You can get from 130 to 160 thousand kilowatts out of the Osage, and 135,000 out of the Keokuk plant.

6401 Now to illustrate the actual method of operation, Keokuk never gets below, in an ordinary year, say, 70,000 kilowatts. Any reduction below that is of very rare occurrence. That being the case, that 70,000 kilowatts of water power energy would either go over the dam or we must make use of it. So it is placed first, it carries what I would call the base load, 24 hours a day.

Then the steam plant, the best unit available at the time, probably 75,000 in our case, would be placed next, and operated at its maximum efficiency point.

Then the next less efficient unit, and so on until we
6402 finally get to the reserve plants, some of which may be actually shut down cold.

In certain years, Rivermines will not be operated at all. In other years it will be operated for a very short time.

Now that is the type of operation for which the Osage plant is primarily designed.

On the other hand, suppose that instead of having a very lean or dry year, and what we call a low send-out for water power, suppose we have a very good year. Also let us assume

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that we may have just installed a new large unit such as the plant which is now under construction. Under those conditions we would not have to reserve Osage specifically to cut this winter peak, we could use it any way we wanted to for that year.

And what we do do is to try to schedule the operations in such a way as to get the greatest number of kilowatts, kilowatt-hours, out of that plant in that year.

In the years just before such a unit is to be installed, the
greatest value that Osage can be to us is to make a firm 6404
cut-off of this 200,000 kilowatts, even if we have to sacrifice a few kilowatt hours. The result is that in making that firm winter cut-off, we schedule the level of the reservoir by what is known as a rule curve. We have checked the rainfall for 60 years, we have checked the records the years the plant has been running, and we know what the minimum rainfall we can count on for the next certain number of weeks is. It may be greater than that and probably will be, but that is the least.

Now, in pulling down the reservoir, you have got to watch
two factors. One, you must not get it so low that you can't 6405
get it back full ahead of its winter peak, even though you have got the lowest rainfall on record. So whenever you get down to the point at which minimum rainfall would

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just bring it up, th you quit drawing it down and start running your lower efficiency steam plants.

On the other hand, if you pull it down too far, then, even in an ordinary year where you are not concerned about the winter peak, in trying to get more rainfall in the reservoir

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you may overdo the job and have the effect of operating your storage reservoir at a lower head than could otherwise have been done.

So it is really a very nice engineering operation and calculation day by day to watch this operation and see to it that the plants are scheduled to get the greatest good not only from the equipment, so as to keep fixed charges at a minimum, but from the hydro plant to get all the kilowatt hours you can, and from the steam plants to be sure you are
6407 operating the most efficient unit for the particular work at the time.

The usual way of expressing this operation is to state that a duration curve is constructed which can be described as a curve in which the ordinate is kilowatts, and the abscissa is hours per year up from zero to 8,760, or the total year.

The product of hours, times kilowatts, is kilowatt-hours, or energy. The result is that the area under this curve represents energy, and any particular height on the curve represents the kilowatts at that point, and the length over

6408 to the right of the curve indicates the number of hours per year at which that particular load is used.

For example, suppose that the system peak for the winter of 1940 were to be 500 or 515 thousand kilowatts. If we took 200,000 kilowatts off of that, that would leave us 315,000 kilowatts. Now we would examine this curve at the height of 315,000 from the bottom, and go horizontally over until we intersected the curve, and that would tell us how many hours that 315,000 kilowatts would have to be carried.

At the top of the curve we know that it is just one hour, and working out each step there, we can determine the num-

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ber of kilowatt-hours that it would take to cut 200,000 kilowatts off of our 1940 winter peak.

Then we analyze the storage of the reservoir and we find that the reservoir just has enough kilowatt hours to do that, including the rainfall that will be acquired, even on a minimum year.

All of these calculations have to be made in advance. They are corrected as fast as the actual figures are available, but we have to assume in these operations that each estimate ahead is based on a minimum year, and then correct it 6410
as quickly as the actual figures are available.

By that process of cut and try, each day, and correcting a preliminary estimate and finally getting it pretty accurate,

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we schedule the operation of both the hydro and steam plants in conjunction with each other, so that the hydro cuts this firm peak and at all other times, when it has excess water, we use it for kilowatt hours, and shut down our big units for overhaul during the period of flush water, and by that I mean during the spring months, about three months. 6411

It is possible to overhaul two of the largest units on the system during the period of the plentiful water power in the spring. At the present time we have occasion to only overhaul one, because we only have two of those units, and we alternate them, each one every other year.

If we were to acquire another large unit of equivalent size, or even slightly larger, there would be certain years in which we would want to overhaul two large units in the same year, and we could schedule both of them in that period.

During the valley of the load, after the summer peak is over, there is opportunity to overhaul one of our next largest units, such as the 50,000. By that method we operate with a satisfactory and safe reserve, and still try to keep the economy in mind at all times.

The hydro plants provide marvelous, quick-starting reserve, whereas, these large steam units require several hours to bring them up to load from cold, because we do not dare

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6413 heat them up quickly.

So that at any time at which we were holding the reservoir full, and not using very many kilowatt hours, intending to cut this winter peak each day, we always have available this reservoir with a capacity of from 135,000 to 150,000 kilowatts for emergency.

So during that period, if we were to lose a large unit without notice, the hydro plant, particularly Osage, would pick up the load and carry it until such time as we could make other arrangements.

To that extent it provides a type of service that a steam

6414 plant cannot provide.

Q. Do navigation requirements enter into the method of operation of the Keokuk and Osage projects? A. The navigation requirements are very intimately connected with Keokuk operations. There is extensive navigation on the Mississippi River. There is no actual real navigation on the Osage River, and we are required to let through a certain amount of minimum stream flow, but it has very little effect on the operations of the plant. We probably would do almost that anyway.

Q. You might state what those requirements are, and what bearing they have on the operation of the plants? A. Well, the Keokuk plant has to avoid radical or rapid fluctuations of the river. We must not do anything at the plant

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which will interfere with the boats.

For example, if a boat is tied up to a dock in the evening, and if we were to suddenly let through a large amount of water, trying to carry a little short-time peak, the river would rise appreciably, and the boat might be damaged. A 6416
boat would be affected really worse if we were already letting through a good deal of water, and were to shut it off. Then it might ground.

The result is that we have to operate with great care so that nothing will interfere with the river, and we are subject to the requirements of the War Department Engineers, who control river operations.

I may say that they are becoming a little more rigid in their requirements lately, which is brought about by the operation of this series of dams that have been constructed
north of Keokuk to provide this navigation channel to Min- 6417
neapolis, and we haven't been able to tell yet just what effect that will have, numerically, but we think that those regulations will somewhat reduce our possible output at Keokuk, but it will not be serious.

Q. Now you have spoken of various estimates that have to be made of rainfall and the effect of weather conditions on storage capacity of the hydro-electric plants. Who makes these estimates? A. What individual?

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6418 Q. What department or individual? A. The hydraulic department. The individual is this same gentleman, Mr. Albion Davis, of whom I spoke previously with regard to his contributions to the art of turbine governing. Mr. Davis is the chief hydraulic engineer for the company, and was originally located at Keokuk for many years.

Q. Are these studies extensive and are they continuing? A. They are, they are quite involved. I attempted to explain only just the high spots here, and the simplest part of the

6419 calculations, and indicate the nature of the problem, but still you could not possibly go into all the details in a conversation or in any kind of testimony.

I have a few statistics here, one or two of which may have been given, but I would like to mention them for the system as a whole.

In 1939, the net generation was 2,468,395,631 kilowatt hours. The peak load was 476,000 kilowatts, but we have since attained a load of 489,000 kilowatts, on July 9, 1940. The load was increased from 476,000 to 489,000 in 7 months, or a little over 6 months. The increase in the use of kilowatt

6420 hours during the current year is greater than the increase in demand. Such studies as I have been able to make of this feature indicate to me that there are a number of industries

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already operating on the night shift, as a part of the National Defense program. There is no other explanation for it.

We have examined all the factors that are available to us, and that is our conclusion.

Q. So that you are picking up load at off-peak times during the day? A. That is right. We made an analysis of our

minimums, rather than maximums; in other words, analyzed the highest night loads in the middle of the night, and we can see that those have come up appreciably, and although we don't have any specific knowledge of who these customers are, or just what is going on, I expect we could attribute quite a bit of that to possibly the shoe industry. The International Shoe Company has received a major contract already.

The coal burned during the year was 1,123,537 tons. That is a good many tons a day. At the same time, we must always 6422
keep in mind that in a normal year, normal hydro year, roughly speaking one-half of the kilowatt hours is generated by water power, and that has a major effect on the operation of our system, our steam system, and on the type of equipment that we can use; and you must always keep that point in mind in any comparison of the Union Electric Group with any property which is operated as a straight steam system. The hydro operation has a very marked effect on the

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system as a whole. Obviously, hydro kilowatt hours, having already acquired the plants, cost very little. In other words, 6423
the total annual operating expense of a hydro system is practically constant, year-in and year-out, and amounts to less than .2 mills; in other words, it is less than 1/10th of the production cost of a steam plant.

So that at any time we can get a large amount of water power, our total average cost of production per kilowatt hour goes down. The efficiency with which we produce it may go up. The totals go down, but the unit costs go up, so those things have to be taken into account.

6424 *Colloquy*

Mr. Hamilton: I think this represents a good breaking point, Mr. Examiner.

The Examiner: All right, we will recess until tomorrow morning at 10 o'clock.

(Whereupon, at 4:35 o'clock p. m., a recess was taken until 10 o'clock a. m., Thursday, October 24, 1940.)

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BEFORE THE

Securities and Exchange Commission

Docket No. 59-10

IN THE MATTER

of

THE NORTH AMERICAN COMPANY, *et al.*

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Hearing Room 622,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Thursday, October 24, 1940.

Met, pursuant to adjournment, at 10 o'clock a.m.

Before: W. W. SWIFT, *Trial Examiner.* 6429

Appearances:

S. PEARCE BROWNING, JR., and CHARLES S. HAMILTON, JR., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for the Respondents.

RALPH C. BINFORD and HERMAN ODELL, Attorneys for the Securities and Exchange Commission.

PROCEEDINGS.

The Examiner: The hearing will come to order.

Mr. Hamilton: Mr. Stokes, will you resume the stand?

Whereupon, STANLEY STOKES resumed the stand and testified further as follows:

6431 *Direct Examination by Mr. Hamilton (Continued)*:

Q. Mr. Stokes, you were describing the operations of the generating system. Will you continue with that statement? A. We have mentioned that the bulk of our steam power generation is produced on the Illinois side of the river at St. Louis. There is very good reason for the location of the Cahokia steam generating station at that point. There is a difference in freight rates on coal which today amounts to 30 cents a ton, as between the West and the East side of the river. That difference has varied. It used to be 25 cents a ton for a good while, but in the last year or so, has been
6432 made 30 cents. That is known as a "bridge arbitrary". It is simply a difference in the freight rates from the coal fields to those two points. That makes it much cheaper and much more economical to produce the power on the east side of the river. The transmission of power under the river by submarine cables is more economical than hauling the coal across the river when consideration is given to the fact that we only have to transmit about half of it, half of it already being used

on the east side.

Coal in the St. Louis district and the Southern Illinois field has a low fusing point ash, and a relatively high sulphur content, which has necessitated much experimentation to avoid slagging of boilers. The bigger the furnace becomes, the higher the temperature of the gases leaving the furnace, if the pounds of coal per cubic foot of furnace volume are kept the same. That is more or less obvious, because in a large furnace the walls of the furnace do not represent as big a percentage of the volume as they would in a small
furnace, That is to say, the cubical content varies as the 6434
cube of the lineal dimension, and the area of the wall goes up as the square of the lineal dimension, and you don't have as many square feet of cooling surface in the walls per cubic foot of volume of furnace as the furnace gets larger.

The result is that you reach the point, unless care is exercised, at which, with low fusing point ash, the tendency is for the ash to stick to the boiler tubes, to coat them, and that causes trouble.

There is also a tendency, if you try to crowd the furnaces too rapidly and burn too much coal per cubic foot of furnace
volume, to cause the ashes to slag and become molten, and 6435
when that cools it is difficult to remove.

The result is that we have to give different treatment

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to boiler design and operation in the Middle West than is done in the Eastern part of the country with different coal.

All of those things are learned by experience, and we are not obtaining very satisfactory operation, whereas, when Cahokia was first started, we had many difficulties in burning that coal successfully in the big units.

The circulating water for the condensers, which is taken from the Mississippi River—and incidentally, we pump every day several times what the City of St. Louis uses in their waterworks system, to cool the condensers—this water contains much suspended matter, particularly during flood periods when it would be full of fine silt as well as other things which would be too fine to be taken out by the screens, but which would still affect the condensers.

As a result of that we evaporate all of the make-up water
6437 which is added to the boilers, so that only distilled water is used in the plant. That, of course, avoids many other difficulties which would be involved if raw water were treated and used.

The situation over at the Ashley Street plant in that same connection is quite different because of the steam heating requirements there, where as much as 600,000 pounds an hour, under peak conditions, may leave the plant and not return. It goes out to the steam-heating customers, and they don't return it to us, so we have to make that up by very elaborate

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6438 methods.

Now in the summertime we have rather unusually high water temperatures. This is conducive to the growth of algae, which is an animal growth and which forms on condenser tubes. We had to give careful study, through many years, as to the most practical and economical methods of combatting that difficulty. We chlorinate the water to inhibit the growth, and clean the condensers regularly and dry them out. The drying of the tubes by means of blowers very successfully kills the algae.

Q. Will you state for us now the advantages to the Union Electric Group of having a combined hydro-electric and steam plant generating system? A. There are many advantages in a combined steam and hydro system. For example, it is known that the levees along the Mississippi River north of St. Louis, as now constructed, are probably not at all safe for the highest water recorded, which was 1884 high water. No such level has approximated this figure since, but there is no reason to believe but that at some day it can again be reached just as in the Ohio River Flood. We made quite 6440
a study of the levee situation, and decided that we would have to, in so far as possible, protect ourselves, and we spent about $300,000 on building a levee of our own around the plant property.

However, if the regular Mississippi River levees were to break anywhere above there, that whole area would be flooded in the East St. Louis district, and we would be

unable to get coal in to the plant for some time. We think that we can keep the water out of the plant. We have made very special provisions to bulkhead every opening, and the 6441
levees and walls, and other protective features are carried up above this 1884 high water elevation.

At the same time, the district itself would be unable to use power in any extensive amount for a considerable period, that is, the part that would be flooded contains a large amount of power-using industries. The result is that with our Keokuk and Osage plants, we would have no difficulty in supplying all the power that could be used during such an emergency, most of which would be used on the west side of the river.

So from that standpoint, we have a certain factor of safety which would be difficult to obtain in any other way.

As another point, in the tornado to which I referred previously, and which put out of commission our Venice plant for a period of two or three months, that tornado very narrowly missed a power plant—or a similar tornado, it wasn't the same one, but one which was just as destructive —barely missed a power plant to the south of us. It didn't belong to us, but it illustrated what could happen.

6443 And with this hydro power available, we feel very much more comfortable than we would if we didn't have it. Now we don't believe that a tornado would destroy the Cahokia

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station so that it could not be rebuilt in a very reasonable length of time, but it would be possible for a tornado to tear down the stacks. Now after such conditions, with all of our interconnected facilities, we could continue operation without the thing becoming of calamitous proportions, while the stacks could be temporarily repaired.

Without the reserve, I don't know just what we would do.

6444 The next feature that I would like to mention is the fact that it was clearly demonstrated to us during the other World War, when coal became prohibitively expensive, and it was difficult to obtain cars to get it to the plant, the cars were all in priority service of some kind or other—and during that period, the Keokuk plant produced each year apparently its all-time high up to that point. In other words, we had very plentiful water power from Keokuk all during the period, and at the same cost, and no increase, at which it had already been supplied.

So that the water power, whose operating costs are constant and very small, has a certain stability. They do not vary with conditions. Let's take the present situation today. We may be going into a period of rapidly rising costs. Coal will increase in price, and coal represents a large percentage of our total production cost. Both hydro plants will continue to do the same as in the past, and we hope that we might be fortunate enough under those conditions to run

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into several years of good water power, just as we have been through in the last four years. Now all those factors make the hydro-steam combination act like a balance wheel one to the other, and the combination has a number of features that are not at all apparent from a casual viewpoint. 6446

There is a certain degree of stability there. If costs of equipment are to change rapidly, increase, the hydro plants require no change. The river flow is constant, and we never have to expand them, and they have such long life and very low fixed charges; it is necessary to go through the calculations in order to notice the difference in the annual fixed charges on a hydro plant, in a location where there is practically no obsolescence, as compared with a steam plant where both depreciation and obsolescence are increased. 6447

I might explain that obsolescence feature. Keokuk, which was installed in 1912 and started in operation in 1913, has had no occasion to change any switches or other devices because they were inadequate to handle the short-circuits or the currents. It is perfectly understandable, because the river itself is still producing the same amount of power and we aren't adding to it.

At Cahokia, or any of the city plants, the rapid addition of additional units, sections and features, cause the earlier equipment in many cases to become obsolete, and it has to be

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removed before it is worn out.

The production costs of hydro-electric power are substantially a constant quantity, and amount to less than .2 mills per kilowatt hour. In other words, once you have bought a hydro plant and have it installed, the cost is very little to
6449 run it. And that cost is just the fixed charges for a certain fixed operating crew, transmission line maintenance, and other items, which, in comparison with the production costs of steam power, is almost negligible.

The main cost, of course, in the hydro plant is the investment part, that is, the fixed charges on the investment.

In examining the costs of our total plant output, we have to keep that in mind. For example, if steam generation is 30 per cent. of the total generation, then the unit cost of production for the system will be roughly 30 per cent. of the unit cost of the steam production. Likewise, if steam pro-
6450 duction were 60 per cent. of the total, then the unit system production cost would be roughly 60 per cent. of the unit cost of steam generation.

In other words, the amount that the hydro adds to the total cost is so little, that if you were to produce 50 per cent of the output by water power, and 50 per cent. by steam, your enumerator would simply be the total cost of steam production, the other would be negligible. In the denominator you would have twice as many kilowatt hours, so our total

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system costs would be about half.

The hydro plants have been discussed as producing a reliable annual peak cut-off of 200,000 kilowatts as of today, with a possibility of extending this to 225,000 kilowatts by the time our load reaches 600,000 kilowatts.

I should like to mention that the highest all-time combined output of those two hydro plants has been 278,950 kilowatts. I mention that because I want to show that our 200,000 kilowatt figure which we put in these reports as dependable combined capacity of these plants, is materially less than their highest record. 6452

But it is as high a figure as we believe is conservative and can be depended upon through the winter peak.

During the high-water season, as we have previously pointed out, we take the base load of the system on the hydro plant, and oftentimes all of the units are operated, as referred to in the operating unit as "against the stop". In other words, if you can set a water wheel at its most efficient operating point, and lock it there, fix its governor so it won't change, and let the steam system do the governing, then you have the maximum efficiency in your hydro plant, and get the most out of the water. 6453

At these times we have customers, at Keokuk primarily, who can take power all the way from nothing up to 30,000 kilowatts. These are known as dump power customers, and the sale of this power we refer to as excess power. It is sold

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to these customers, people like du Pont and others, who make a product such as 50 per cent. ferro-silicate, which can be stored and can be held profitably until the market requires its sale, and they take advantage of the low cost at which we can sell this type of product, to produce the ferro-silicate.

We are not required to guarantee the delivery of that power, and it therefore acts just like a reserve plant as far as we are concerned. We can discontinue it at will, or upon relatively short notice.

So that that feature is an interesting part of the operation of a hydro plant, that there is a good deal of water power which is not continuously available and for which you do not care to make a continuous investment, but which returns both to the consumer and to ourselves a very nice
6455 and profitable return. The customer return is in terms of very low cost power, and ours is because we do not have to charge against that type of power any fixed charges.

There is another class of service which has somewhat those same characteristics, in which we have sold a very limited amount, known as what we call our 60-cycle reserve service. That is not an important item, about 5,000 kilowatts of it; and it is the type of load where the customer can either discontinue for a while, or has another source of

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supply, and on moderate notice we can discontinue his load
6456 in the event we need the capacity for our regular firm customers.

The frequency changers which have been referred to previously as being very economical and saving considerable water power, actually used or converted 100 million kilowatt hours a year for over five years during the depression, which would otherwise have been unusable and would have been wasted. That was the basis of the statement which I made, that they had saved roughly $2,000,000. I believe that valuates this energy at about 4 mills.

During the low water season, we utilize the hydro generation in combination with the steam to reduce the steam plant operating costs. This is without reference to the detail of how we do it, we fit it in carefully at the place where it will produce the greatest economy.

The spinning reserve benefits in quick starting were mentioned with respect to Osage previously. That is to say, we pointed out the fact that you can pick up load in less than three minutes. We did not mention, however, that the use
of this spinning reserve costs about half what it does to keep 6458
a steam turbine in reserve. It is economical to that extent, that it will not only start quicker, but it actually is very much cheaper to handle than the turbine, when carried for reserve operation. You cannot run a steam turbine at zero

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load, you have got to have a little load on it, and that means that you are generating kilowatt hours at lower efficiency under those conditions.

Q. Now where is control of the generating system centralized? A. Control of the plants which have been described,
and all of the lines and so on, for the Union Electric Group, 6459
is centralized in a system load dispatcher, and his group of system operators. The whole system is handled exactly as it would be if it were just one company, and the system operator or chief load dispatcher has full authority to see that the plants are operated in accordance with his instructions, and also his operators handle the switching of lines when it becomes necessary.

Q. Where is the chief load dispatcher located? A. He is located in our 12th Street Office Building. We have a

large downtown office building in which the top floor is given over largely to the load dispatching facilities. We have rather expensive control boards, and elaborate facilities for communication. We have what are known as Selsyn equipment. That is an interesting type of control in which the position of any kind of a rotating device at one location can be transferred to another. It isn't practical to transfer metered circuits several miles, as there would be losses, and there would be lots of reasons why you couldn't do it. But

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we can transfer the position of a meter hand at Cahokia to the same position on a board at 12th Street, by what is known as the Selsyn control.

It is a relatively simple device. If you take a three-phase motor and supply the fields from a common source, and these two motors are located at remote points, you can arrange those so that they will take the same position exactly. If one is moved half-way around, the other moves with it. These motors do not rotate continuously, but they are designed and built just like a motor, and if we turn this one, the other
6462 will turn exactly with it. If this is regarded as a master control, I can have as many as I want of these others at different locations, and each will take the same position.

So that if that little device is attached to a hand at Cahokia, and is made to follow the meters over there, with the meter scale and a device that looks like a meter over at the 12th Street office, the operator can read exactly the same thing.

If the meter at Cahokia were to say 100,000 kilowatts, this one at 12th Street reads 100,000, and the load dispatcher can tell what the loads are at some of the key points.

That is only one of the features. We have, of course, the customary board with its mimic buses, and little lights, and relays, and all other things that go with an indicating system so that the load dispatcher and his operators can have

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full information at all times as to what position all major switches on the system are in; also as to what turbines are on load, and approximately the loads handled by those; and exactly the loads taken by the plant as a whole.

We do not remove from the manager of the Cahokia plant 6464
the responsibility for keeping his stuff in regular operation, and the load dispatcher in a system of this type does not attempt to take over the detailed operation of a plant. In fact, the less he knows about it, the better off he is, because the man best equipped to take the responsibility for the thing is the man at the plant. All the load dispatcher needs to know is information which is essential to coordinating system operations. In general, the load dispatcher is really a man who schedules and predetermines the plants, wheels, and other apparatus which is to be used a few hours or a
day later, and the system operators are those who carry out 6465
the detail operating.

The hydraulic engineer, for example, gets forecasts of the rain in the reservoir, the rainfall, and we have weather report stations up the river, and we have telephone communication with those stations. We have men available to check all of the hydrographic features, and all that information is accumulated in the central office, and with the calculations to which I have previously referred, this hydraulic engineer gives to the system load dispatcher the basic information as

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to what the hydro conditions are expected to be the next day, for example.

With that, the load dispatcher determines the loads that he will have to carry on his steam plants. In addition to that, we subscribed to an experimental form of weather service to try to even amplify the amount of information available as to the weather. I don't believe that that in itself was so very successful, we didn't think it would be, but we didn't want to overlook any opportunities. But it did stimu-
6467 late the Weather Bureau itself, who I believe didn't particularly enjoy private groups going into the weather forecasting business, and they set up a four-day forecast, four or five days ahead.

We have been getting it, on the regular weather maps, about one day ahead, but they forecast the thing four days ahead continuously, and they have only been doing this about four or five months, and so far they have been marvelously perfect. They have done better than the private service, and if they continue to be as good as they are now, it will be of great help to us.

6468 So that the load dispatching is primarily one of knowing what the hydro plants are going to do, scheduling them in combination with the system, setting up the requirements for each machine on the system, so that the ultimate end is the most economical over-all combination that we can produce, and conditions change from day to day, and it re-

—2,765—

quires continuous attention. You can't set it up and go away and let it alone.

The other predictions, which I should say are a part of this thing, are the load predictions. That is, I have referred

to the other predictions, and I should also mention that it is also necessary to predict the load itself, what we are trying to handle.

We occasionally get upset on some of those predictions because of an extremely dark day, due to smoke or fog that was not contemplated, and which will increase the load. But in general, from previous experience we know that if the load was so-and-so last Tuesday, that next Tuesday it will be similar; although Wednesday it will be different; and from our knowledge of the characteristics of the load 6470
each day, they are able to set this thing up with surprising accuracy.

The load dispatcher predicts these things, I think, with more or less uncanny accuracy. That is just a matter of years of experience.

Q. How is the flow of reactive power controlled in the system? A. In order to answer that question, I should make as simple an explanation as I can of what is meant by reactive power. Briefly stated, when a motor which is driving a mechanical load is supplied over a transmission line from a power plant, it has to receive two components of power, 6471

one what we call the kilowatt component, which provides the mechanical force to drive the motor and do the work; the other, the reactive or kilovar component, which provides the magnetizing power to provide that all of the magnetic circuits of the equipment are properly excited or energized.

This reactive power has a more definite effect on voltage drop around the system over apparatus through transformers than the kilowatt load itself. The kilowatt com-

ponent is affected largely by merely the resistance of the circuit, whereas the reactive component is affected by the inductance of the circuit.

In the early days of plant operation, little attention was paid to reactive power. No metering equipment was provided, and all we talked about were kilowatts. Today we have produced a means of metering the reactive power in a manner equally accurate with that of the kilowatt power. We have our kilowatt meters and our reactive meters,
6473 separate instruments.

This measuring of reactive power in itself is not new, it has been done for years, but the problem always seemed to arise, when one plant operator was trying to get another plant operator to pick up reactive, as he would say, ask him to take more of the reactive load on his plant, change the excitation of his machines, for example, in order to control the voltage, you do raise the voltage at one point and lower

—2,767—

it at the other, by simply shifting the flow of reactive power between the two plants.

6474 In attempting to do that, there always seemed to be a misunderstanding as to what direction of flow we were talking about. The thing is purely arbitrary and we have, as a result of analyzing the definitions and setting up some arbitrary directions, and by changing directions of about 25 per cent. of the reactive meters on the system, we have, a few years ago, a standard direction of reactive flow, and there is no longer any question in the minds of the operators what they are talking about, and we carry out the dispatching of reactive power just exactly the same as we do the

kilowatt power, and to that extent I think we are somewhat original in this method.

We have found it to be extremely important, and we have the facilities to do it, we put them in. By that I mean, if you did not have load ratio control transformers, whose transformation ratio can be varied while they are operating under load, you couldn't do very much about it anyway. All you could do would be to vary the excitation of the fields of your generators.

6476 On our system, all of the major points are equipped with these devices, and in addition we have condensers operating at Page Avenue sub-station, Rivermines sub-station, we have the corrective capacity of the generators in each of the steam

—2,768—

plants, and with those facilities we are able to maintain satisfactory voltage and not have an excessive flow of amperes, which is just wasting energy and making losses throughout the system. And it is a real pleasure to see the thing work if you have put in so many years gradually approaching this goal.

6477 The recently installed generators are all provided with at least a k. v. a. capacity in which we can handle .8 power factor loads, without overloading the generator; in other words, they are rated as .8 power factor generators.

The voltage control which I speak of was largely directed towards the transfer of power and reactive k. v. a. between plants. In addition to this, of course, any system operating long transmission lines—and we have a number—requires that the lines themselves be controlled with synchronous condensers. There is nothing novel in this at all, and I make no

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claims for anything original on that, but the facts are that we do it, and do a good job of it, and we did one thing which was somewhat original, and that was the combining, in those frequency changers at Page Avenue, of the capacity to permit them to act as large condensers, and by that simple means we saved the operation of a complete duplicate set of machines, because those were going to run all the time anyway.

We have to dispatch the handling of those condensers
6479 with great care, because, although they are automatic in operation, the position of the automatic equipment is under manual adjustment, and the stability limits of these trans-

—2,769—

mission circuits are affected very quickly by the method of operating these condensers. So that the operators of a system of this type are not only skilled men, but they have to be of rather high type electrical men; they have to have considerable electrical knowledge. Practically all of our men of that type are largely—I think I am safe in saying a large percentage are—university graduates. All the men we hire
6480 today, who are intended to be graduated into that class of work, are university graduates.

The combination benefits to be derived from a hydro-steam system have great possibilities, but in order to obtain those benefits, extreme care has to be exercised. We feel that we are getting as much out of those plants as we possibly can, and it takes continuous application to do it.

Q. How is frequency controlled on the system? A. Frequency is controlled on our system by manual adjustment of the main turbines at a very gradual rate. We never allow

the frequency to vary more than plus or minus 1/10th of a cycle. That is exclusive of some possible sudden short-circuit, or something which, for a few seconds, might pull it down; but normal frequency is controlled within plus or minus 1/10th of a cycle, or plus or minus .05 cycles for the 25-cycle system, the 1/10th cycle representing the 60-cycle system.

If there are 60 cycles a second, 1/10th of a cycle would

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be 1/10th of 1/60th of a second. We use Arlington time signals, which are dispatched to the plants by the telephone 6482
system three times daily. The maximum total accumulated time deviation, which, as far as I know, never occurs on the system, but which we agreed could occur without damage, will be plus or minus 3 seconds, and the regulating stations initiate corrections and try to maintain the time accurately within plus or minus one second. That is, there is never any accumulated error, that is the maximum amount by which the system might vary ahead for a little while, and then vary back, but on the average it is corrected and maintained absolutely correct at least three times a day.

The application of automatic time control equipment pro- 6483
duces a chart which is very little different from the one that we have. We could install the equipment at any time we want to, and have considered doing so, but the necessity for it did not appear to arise. We were not able to economize any on operators, because they had to be there for other reasons. And unless we have a closer requirement for time than now exists, we see no particular reason to install what is known as the automatic controller. That, however, can be installed at any time, and the turbines and all of the equipment are arranged to receive it.

Q. How is spinning reserve distributed over the system? A. We maintain spinning reserve, that is, turbines actually

—2,771—

operating and connected to the system, equal to our largest unit, which is 75,000 kilowatts. This has been previously mentioned.

The answer to your question is that we distribute this spinning reserve over the different parts of the system in such a way that failure of connecting links will not cause
6485 any loss of load due to lack of reserve. That is, there are essentially on our system what we call the north part and the south part, and if we were to put all of our reserve on the south part of the system, and then operate circuits in such a manner, as is occasionally done, and which becomes necessary at times, that this reserve would not be able to be placed on the north end of the system, in the event of transmission line trouble between the two parts, we would then place some spinning reserve on the north half of the system, even at an increased operating expense.

Of course, it is always cheaper to maintain your spinning
6486 reserve in one large unit at your big plant, but it will not always take care of the requirements of reliability of service, and we sacrifice, under those conditions, economy in operation to reliability, and split the reserve up and place it where it will do the most good.

In this combination of spinning reserve is where we make the most beneficial use of the Osage plant. If we had to

—2,772—

or at Ashley Street, and run it hour after hour, it would be place a small steam turbine on north half of our system,

much more expensive than spinning one of the wheels at Osage.

Q. What has been the record of the Union Electric Group with respect to reduction in operating expenses per kilowatt hour? A. The operating expenses in what there was of the Union Electric Group in 1902, were over 3 cents a kilowatt hour. As a result of the advances in the art, through economies resulting from consolidation and unification of a number of operating companies, operating expenses have been reduced to approximately 5 mills per kilowatt hour 6488
sold. These figures do not include taxes or depreciation.

The variation in these operating expenses is affected by water power, as has been previously referred to.

Mr. Hamilton: I will ask the reporter to please mark this sheet as Respondents' Exhibit No. 53 for identification.

(Respondents' Exhibit No. 53 was marked for identification.)

By Mr. Hamilton: 6489

Q. Will you state what this exhibit represents? A. This Exhibit No. 53 for identification represents the net output of energy of the Union Electric Group in millions of kilowatt hours, by years, from 1926 to 1939, inclusive. In addition thereto, it gives the operating revenue in cents per kilowatt hour sold, the production expense in cents per kilowatt hour

—2,773—

sold, and the total operating expense in cents per kilowatt hour sold, for the same period.

Q. This table has been prepared under your supervision? A. It has.

Q. And the facts shown are taken from the records of the respective companies indicated? A. They are.

Mr. Hamilton: I offer this in evidence as Respondents' Exhibit No. 53.

Mr. Odell: No objection.

The Examiner: Let it come in under that number.

6491 (Respondents' Exhibit No. 53 was received in evidence.)

Mr. Hamilton: I call attention to the fact that the exhibit indicates an increase in net output from 1,326,830,000 in 1926, to a figure of 2,468,420,000 in 1939; and that it shows during the period indicated a decline in operating revenue per k. w. h., a decline in production expense per k. w. h., and a decline in operating expense per k. w. h.

I will ask the reporter to please mark this sheet for identification as Respondents' Exhibit No. 54.

6492 (Respondents' Exhibit No. 54 was marked for identification.)

By Mr. Hamilton:

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Q. Mr. Stokes, will you state what this chart, Respondents' Exhibit No. 54 for identification, represents? A. This represents the b. t. u. per switchboard kilowatt hour, for the Cahokia steam generating station, for the years 1924 to 1939.

Q. Has this chart been prepared under your supervision? A. It has.

Q. And the facts shown are taken from the records of the respective companies indicated? A. They are.

Mr. Hamilton: I offer this in evidence as Respondents' Exhibit No. 54.

Mr. Odell: I have one question before that is admitted.

I would like to have the witness explain what this
phrase, "per switchboard kilowatt hour" means, as it 6494
appears on this chart?

The Witness: That is a net switchboard kilowatt hour, I believe—if I find that to be in error, I will make the correction promptly.

Mr. Odell: You mean that there is some question in your mind as to whether that is net or gross?

The Witness: There is, because that wording there, which I had not previously observed until I read it here, the heading of the sheet, is indefinite, and I have given the statistics in the record for output figures.
For example, in this exhibit here, 53, those figures 6495

—2,775—

are net kilowatt hours. I have also previously given some figures on total gross kilowatt hours, and although this was prepared under my direction, I did not do the exact work, and I am not quite certain whether that is gross or net.

Mr. Hamilton: Will you verify that, Mr. Stokes, and let us know?

The Witness: Yes.

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Mr. Odell: I suggest that we withhold the receipt of this exhibit until that is clarified.

The Examiner: Subject to supplying that information the chart is received as Respondents' Exhibit 54.

(Respondents' Exhibit 54 was received in evidence.)

By Mr. Hamilton:

6497 Q. I note from the chart, Mr. Stokes, certain variations or fluctuations over the period shown. Will you indicate briefly the reasons accounting for those fluctuations? A. They are brought about by the variations in hydro output, as previously mentioned. The year 1935, which has varied upward, was the result of extremely good hydro conditions, and the operation on the steam plant was at a very low rate, and we had difficulty in maintaining load enough to get up to the efficient point on the units. In 1935, as you recall, was in the depression, just coming out of it, and the combination

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6498 of a good hydro year, with the low level of load, caused inefficient operation on the steam plant, but low total costs. Whenever you see a condition like this, with high b. t. u. per k. w. h., or relatively low steam plant economy, you will find a correspondingly lower total annual production cost, because it merely means that a large number of hydro kilowatt hours have come in there with hardly any expense.

Now if you took the year 1937, the first six months of 1937, the hydro power was very good. The average Cahokia load was only about 50 million kilowatt hours, causing poor

fuel economy at that time due to the fact that the hydro power was good. Have in mind that I am talking about efficiency of the operation of the turbine, and not total system cost of production.

This was followed by six months in which the hydro power had declined suddenly, and did cause a record high output from Cahokia. This put the operation of all the equipment at a point close to its capacity rating, and was above its efficient point, which would be about three-quarters rating, or a little above that. So that again caused a loss 6500
in economy.

In 1936, which was between the two, that was one of the poorest hydro years we have had, and that showed the effect on the steam plant by improving their economy.

—2,777—

In 1938, the improvement in economy there was the installation of the No. 6 turbine, a 75,000 kw. unit, which went into service at the end of 1937. At the same time, there was a marked recession in loads which began on August 13, 1937, and we suddenly dropped load rapidly, and that left Cahokia's output rather light, toward the end 6501
of the year. This, together with good hydro conditions again in April, May and June, resulted in a rather low annual output for the year, but the installation of the turbine caused a drop in the following year.

In the year 1939, you will notice that it has dropped down, and that is brought about by the new turbine itself being more efficient than the other units except No. 1, which is about the same.

Q. In order to make the curve clear, will you state whether the point shown for 1924, for example, is an average

for the year, or whether it has any other basis? In other words, does this represent average B. t. u. for 1924, 1925, and so on? A. Oh, yes, it represents the average for the full year.

Q. And will you state the specific figure for 1924? A. 17,600 B. t. u.

Q. And, similarly, the figure for 1939? A. The figure for 1939 is 15,840, as close as I can read the B. t. u.

—2,778—

6503 Q. Are you able to draw a comparison between the figures represented by this exhibit and the B. t. u. consumption for your Ashley Street plant at a period much prior to that shown by the exhibit? A. Ashley Street, in 1904, used 48,000 B. t. u. per k. w. h., and up as late as 1916, used 38,000.

Q. Has the cost of fuel shown a tendency to increase over the period of years? A. Yes, fuel is affected by both the labor costs at the mines, and freight rates, and our fuel costs have increased about 63 per cent. in the last 40 years.

Q. You might indicate, if you will, the general nature of that increase over the period you mentioned? A. Well, from
6504 1902 to 1918, the fuel cost about 6 cents per million B. t. u. From 1917 to 1927, the cost ranged from 13 to 20 cents per million B. t. u. Since 1928, or rather, 1929, we have purchased coal from 10.4 cents to about 12 cents per million B. t. u. Our anticipated, calculated cost for 1941 is roughly about 11.74 cents delivered to the plant, or 11.82 delivered in the bin. Those prices are calculated to take into account the effect of this Guffey bill.

The increase in the economy of operation has kept up with the increase in fuel cost to give a total lower cost of pro-

duction. If the fuel cost keeps on increasing, though, there

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will come a time when we can no longer keep up with it, because we are beginning to approach a theoretical efficiency of our steam plant cycle.

I would like to expand just a little bit on that point. The hydro plants produce in a normal year about half of the total power, and make it more economical to operate a medium priced, medium efficiency plant, than it would if we did not have the hydro plants. For example, we have provided at Cahokia facilities to put in economizers in the first two or three sections. We never were able to show that the installation of those economizers would be an economy; in other words, that the gain in the B. t. u. economy or performance of the station would be more than offset by the maintenance and fixed charges on the economizers themselves. 6506

Keep in mind that our coal cost is not high, relatively. You may get 16 cents per million B. t. u. in the Eastern States.

6507 So that in the later sections we installed air preheaters, we do not use economizers.

In our Venice plant now under construction, we studied all of the various steam cycles to find out which one appeared to have the most merit, and we selected the 850-pound, 900-degree cycle as previously mentioned, which should give an economy of much less than Cahokia. But at the present time, we could not justify, or we could not show any gain in economy—and by "justify" I mean could not prove to ourselves,

in making a comparative calculation, could not show any

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gain in economy by going to a slightly more efficient cycle of 1,250 pounds, 925 degrees. We would really lose money, the overall cost being greater.

Another thing, if we were to install 160,000 kilowatts of this new equipment at Venice, at the present time and with present loads, instead of the 80,000—I am talking about today, now, to bring them in for operation in the winter of
6509 1941—we would be unable to give the additional 80,000 kilowatts a high enough load factor, we couldn't use it long enough hours of the year to produce an overall cost as cheap as we get in Cahokia. We would have to wait several years before our load would be sufficient that we could do it.

Our present system load at the night time is about 250,000 kilowatts, and there are times when we, for very short periods, have that amount of hydro power alone. So I merely repeat at this point the statement made once before, that all of these figures have to be given careful consideration in the light of the method of operation in connection with the
6510 hydro plant. If we were a straight steam system, we wouldn't operate just as we do.

Q. What department or departments operate and maintain the main and subtransmission stations of the Union Electric Group? A. The operation and maintenance of the electrical equipment in the generating plants and sub-sta-

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tions on the main and subtransmission systems, is the duty of what is known as the electrical department. The electrical department has two rather main subdivisions, the power

plants department and the sub-station department, but it is their job to maintain and operate the property under this supervision, and to a certain degree they do construction work. That is, we do our own construction work on all ordinary types of jobs, and about the only time that we ever have done any extensive contract work has been in connection with the installation of a main steam plant or hydro plant.

Q. I think it would be interesting, as part of this description, if you would state the distribution of the demand over the system at the time of a recent peak demand on the sys- 6512
tem. A. We had a recent peak demand, referred to in previous testimony, of 489,000 kilowatts. But on another day in the same month, in a recent month, about July, we analyzed a peak of 484,000 kilowatts, just selected one at random, and made an analysis to see how the load was divided.

These figures that I propose to give you are kilowatts and not kilowatt hours. I am trying to illustrate the division of load where it occurs on the system.

At the time of that system peak of 484,000 kilowatts, we had on the 25-cycle system at Keokuk, in that vicinity, 6513

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66,600 kilowatts. There was no 60-cycle load in that vicinity at that time, so the total peak at that location was as given.

At Hull, which has been located on the map, and with which we are familiar, we had 16,600 kilowatts, all 25-cycle load.

At East St. Louis, we had 6,200 kilowatts, 25-cycle load, and 94,600 kilowatts of 60-cycle load, totaling 100,800 kilowatts.

St. Louis itself had 43,000 kilowatts of 25-cycle load; 184,700 kilowatts of 60-cycle load—or a total combined of 227,700 kilowatts.

Rivermines, Missouri, had no 25-cycle load, and a peak of 37,100 kilowatts, 60-cycle, which is also the total for that district.

I made reference to the St. Joseph Lead Company load as running between 28,000 and 30,000 kilowatts. With a peak of that character, I should say that their load would have
6515 been about 30,000 kilowatts, and our distribution load in the vicinity of 7,000 or 7,500, in that range.

In order to equal the exact peak figures, we have calculated the losses in some parts of the system, and in other parts they are actually measured, with the result that the losses are estimated to be 4,600 kilowatts on the 25-cycle system, making the combined total peak 137,000. The losses on the 60-cycle are calculated at 30,600 kilowatts. This fig-

ure is a combination of measurement and calculation. The combined losses total 35,200 kilowatts, giving a system total
6516 of 484,000, as stated.

The Examiner: We will take a short recess.

(Whereupon, a short recess was taken, after which the hearing was resumed.)

The Examiner: Let us resume.

By Mr. Hamilton:

Q. Is control of the electrical system also centralized in the load dispatcher? A. It is. Control of the generating plants and the flow of energy over the system is centralized

in the office of the load dispatcher, located at 315 North 12th Street, St. Louis.

The Mississippi River Power Company and the Union Electric Company of Illinois, both have load dispatchers who control the switching on their own system under the direction of the St. Louis dispatcher. That is, it is not good business these days to bring too much detailed information into the hands of one man who can not possibly take care of it quickly in an emergency. You must not rob the responsibility of your individual operators; at the same time you 6518
must ret[illegible] rigid control and supervision over them by the central dispatcher. That is the basis of their operation.

When I say that these separate companies have their own

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dispatchers, those dispatchers have a limited scope of operation within their own district, and the general operations are under the control of the main dispatcher. Each man knows just where his responsibility stops, and the other man picks up.

As these systems grew, that was one of the first features 6519
that we had to watch. We over-centralized a little bit, and began to overload the duties of our central dispatcher. Then we had to reanalyze the problem, and today we have authority, for example, in the Cahokia superintendent or manager, to handle the machines under his own supervision. The load dispatcher is automatically notified of what they are doing, and in an emergency the load dispatcher handles the system, and the individual plant operator handles the plant.

At other times, when there is no immediate emergency, the load dispatcher has already scheduled the operation of the units.

Of course, one of the important features in all load dispatching operations is adequate communications of all kinds, and the load dispatcher's office is in direct telephone communication with all generating plants, and in addition he has a carrier current telephone, which gives him an auxiliary means of reaching Osage, Rivermines and Keokuk
6521 in case direct telephone communication is not possible.

I mean by that, that there may have been some storm which has interfered with the telephone lines. Our power

—2,785—

lines are constructed much more reliably than any telephone circuit can be, and under sleet or storm conditions, the carrier current would still be available.

The load dispatcher's board is arranged with direct wire, lamp indication of the position of the generators and main bus oil circuit breakers at Cahokia and Page Avenue substation.

6522 All direct current automatic stations and four of the automatic A. C. sub-stations also have lamp indicators showing what machines are on the system. That, although it sounds like a good many, is a very brief group of indications as compared to what could be done.

All generators at Cahokia, Venice, Ashley, Rivermines and Osage are started, loaded, regulated and shut down in accordance with the dispatcher's orders and schedules.

The dispatcher notifies the Keokuk plant of the load which they are to carry for St. Louis, but the dispatcher in St. Louis does not attempt to specify which or how many of

the 15 units at Keokuk shall be used, that being left to the chief engineer at Keokuk. The dispatcher also has control of and directs the operation of all transmission oil circuit breakers of 6,600 volts and above, as well as the buses of all sub-stations in so far as their primary supply is concerned. When I say "dispatcher", I refer to him and his group. He has assistants.

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All feeders involving direct distribution of energy to customers are under the control of the trouble department, 6524
whether they are at 13,800 or 33,000 volts. Where a feeder serves a dual purpose of transmission and distribution, the load dispatcher and the trouble department cooperate.

To handle the telephone traffic in the load dispatcher's office, each of two load dispatchers have desk-type switchboards with one trunk line direct to the outside, and three trunk connections with the automatic private branch exchange in the building. The carrier current telephone and direct wires to all plants and important A. C. sub-stations as well as the D. C. sub-stations, are brought in on each desk. Either man can pick up the call from the other, the stuff is 6525
all duplicated.

The combination of Bell Telephone service and our own private wire service is completely unified; that is, we have finally succeeded, after many years, in making extremely satisfactory arrangements whereby our own equipment can be brought in, in conjunction with the Bell Telephone equipment, and you don't distinguish when you are on the dispatcher's board. There were many years when the Bell Telephone Company thought that anybody else's telephone system would be dangerous if connected with theirs, but they

have gotten over that viewpoint, and we have a very fine arrangement which is superior to anything that either one of us could do alone.

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For example, in the old days we used to have to go to some other room or phone if we wanted to use our carrier current, or we might have to call a man and have him repeat the message. Today we can operate through the regular board facilities, you wouldn't know the difference, hardly.
6527 You can tell the difference in the quality of the tone a little bit, but otherwise you would hardly know whether you were talking on the carrier or on the Bell wire.

Q. Are the control boards in each power plant continuously manned? A. Yes, in each power station we have a complete control board. For example, at our main plant at Cahokia, there are five men on duty in the control room continuously. These men are assigned as bench board operator, auxiliary board operator, floor man, and maintenance man. The main operator, in ordering—or in operating a switch himself, has a floor man always available to him, where he
6528 can speak to him, whom he can send out and inspect the switch before or after opening, any way he wants to, or if he is opening a switch to put a "hold-off" tag on it for men to go to work, he sends this floor man out and has him open the disconnecting switches and place the tag out there, while the operator places a tag on the control button, so that nobody can close that switch while a man is at work.

The board operators attend to the control of the machines

—2,788—

in the plant, take readings on the meters every 30 minutes, and attend to any switching required by the load dispatcher.

I have made it clear, have I not, that this board I am now speaking about is over in the power plant? I am just taking a typical board.

The maintenance man, whom I didn't mention, or whose function I didn't mention, checks the controls, the rewiring and the operating conditions of the breakers in addition to the ordinary steady maintenance work as carried on by a different crew altogether. This maintenance man is regarded as an operating man and it is up to him to see that certain
of these equipments that are under the direction of the bench 6530
board operator, are examined at regular intervals, in addition to the usual scheduled maintenance work.

Q. How many of your sub-stations are manually operated? A. There are 89 sub-stations on the system, 29 of which are manually operated continuously with one or more operators on duty. Sub-stations, in some cases, are both manually and automatically operated, as is the case where old equipment is still in operation, and automatic equipment has been added.

The division of these various stations by classes may be
stated as main transmission sub-stations, manually operated 6531
—and there are 12 of those. There is no economy in attempting to operate a main transmission sub-station automatically, although there is an improvement in the reliability and con-

tinuity of service by having a large part of the equipment in these main stations automatic equipment. That is, the man is required there for communication purposes and for many other purposes, and we have found where we have added automatic equipment to old stations, that the auto-

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matic equipment can do things that a man can not do, but there is one thing that the automatic equipment can not do, it does not think. It will carry out any predetermined schedule of operations, probably better and certainly quicker than a man can do it, but if the predetermined schedule of operations is not the thing to do at that particular time, the automatic equipment will probably do it anyhow, if it can.

For example, if you want to provide all the features in an automatic station that should be used, and provide a
6533 schedule of what should take place, in the event of a fire, you are very likely to lay down the wrong rules, that is, you have got to assume where the fire is going to start, and a lot of things like that. A man in the station would do something else. So that in these major stations, you have to have so much communication, so much transfer of information, so many other things to do besides operate electrical equipment, that we are not replacing the men with the automatic equipment, but we do add from time to time automatic features, and that is going to be continued more and more in the future, and we finally take advantage of a man's
6534 brains and do not tie him up with a lot of miscellaneous rou-

—2,790—

tine work which automatic equipment could do just as well.

We have 14 manual distribution stations, 49 automatic distribution stations, 3 manual direct current stations, and 6 automatic direct current stations,—in addition to those I previously mentioned.

Q. I don't think you mentioned the automatic main transmission sub-stations? A. The five?

Q. I don't think you mentioned that number. A. Main transmission sub-stations, automatic—5.

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There are grades of main transmission stations, that is, some of them are larger and more important than others. Those are where we have the operators. There are some cases where a sub-station is on the main transmission system. The one that I recited in some detail particularly, the Franklin County sub-station, that is attached to a main transmission line and called a main transmision sub-station, but it is automatic. The type of station I am referring to in this discussion was such as Page Avenue, for example.

Q. How is plant and sub-station equipment maintained 6536
in the Group? A. Each power plant has a machine shop and a force of maintenance men who overhaul all of the rotating and stationary equipment, and even when a major steam turbine requires overhaul, the work is done by our men

—2,791—

under the supervision of a manufacturer's representative. If we are going to take down a large turbine, we always want a manufacturer's representative on the job to see what the condition of the machine is when it is removed from service and opened up. That is largely a matter of division and the proper placing of responsibility. 6537

In addition to those power plant repair shops, I mentioned in the previous testimony that we had one main machine shop which is complete; and where a motor or device of any kind needs overhauling or rebuilding, and if it is so it can be moved, it is sent over to our main repair shop, keeping the amount of work carried on at the power plants at a minimum, the amount of machine work, I mean.

At the sub-stations, the maintenance and repair work is done under the direction of the sub-station department, who

have regular crews engaged in this work the year around. Again, if there is any special work to be done on the sub-station equipment, and if the equipment can be moved, it will be taken over to where our utility repair shop is located, for welding or forging, or such things as milling machine work and things like that.

The utility shop rebuilds distribution transformers. That is one of their main duties. There are thousands of those transformers in service, and they have to be continuously

6539 —2,792—

repaired and rebuilt. We used to rewind all of our distribution transformer cores ourselves, but within the last year or so, we have largely adopted the practice of buying replacement cores direct from the manufacturer. We take the old transformer down, bring it into the shop, take the core out of the tank, clean the tank up, and sandblast it, and repaint it or re-enamel it, and put in a new core, new oil, and it goes back in service in all respects a new transformer. The reason for this change is not that we can not do just as good a job on these cores as the manufacturer—we have the facilities

6540 and do—but it is that the gradual change in labor costs, and increase in quantity production methods in the factories, have made it cheaper to buy the replacement core.

There are lots of other types of work, such as impregnating, baking, cleaning, spray-painting, transformer testing, and similar work, which is done at this utility shop.

Flow painting is a new development being applied the first time this year to paint radiators on transformers. They are relatively inaccessible to a paint brush, and it is very difficult to get them properly painted, and we simply set the

whole transformer in a big tank, lifting it into a big tank by
a crane, and flow the paint right down over it, and it gets
into every little crevice. We think we will not have to paint
them one-third as often, by using this method, as we used
to have to when we sprayed them on or tried to paint them

—2,793—

with a brush.

The sub-stations each require a local battery. That has
nothing to do with the main storage battery that I referred 6542
to as having been eliminated in the Edison system. They
require batteries for operating the oil switches, and those
batteries are maintained by a crew of four men in the Electric
Company of Missouri, the St. Louis district only. The
Electric Company of Missouri is the company which has the
subsidiaries, but it is also an operating company, and I am
referring to it now as an operating company in the city district.

It has this crew of men who continuously inspect these
batteries, and keep them up on a schedule that requires an
inspection of each battery every two weeks. 6543

In a similar manner, we have crews in the other sections
of the Union Electric Group.

Each power transformer on the system is checked every
six months as to breakdown and condition of the oil. If
sludge is forming, or the dielectric value of the oil is low,
filtering is required. Otherwise, complete filtering is resorted
to only on general overhaul. We have portable filtering
equipment, and very elaborate stationary filtering equipment
for oil treating and handling.

Oil circuit breakers have their oil filtered every six months, and indoor breakers are filtered every once in two years, except, however, when an oil circuit breaker has locked

—2,794—

out, after three reclosures, and then the oil is filtered before it is put back into service. The regular crews of the substation department carry on this work.

Q. Is an active program carried on to reduce the occurrence of accidents in the system? A. We have a very active
6545 safety organization. In addition to the various safety groups in each of the departments, who have regular meetings at least once a month, and who discuss all of the latest methods of safety work, we have a full-time safety inspector, who does nothing else but safeguard employees in their work, and try to reduce their hazards. His job is to see that everything in connection with safety work is carried on as it is supposed to be. He inspects all phases of it, and is a full-time employee.

That is not the whole story of safety work by any means. It is quite an elaborate organization. When you take all of
6546 the different groups, and take all of their individual safety groups, we realize that there are a large number of meetings each year, and it is a very major part of the business.

Even on construction work, we have a very carefully worked out organization. On the new Venice plant, we have a hospital on the job, carried on by the insurance companies who are interested in the work. They have an inspector, we have one. We have a little group who get together once a week, and list the accidents or any other things which might

—2,795—

have contributed to accidents, and they make out a report once a week, and attached to that is a daily report of the accident inspection work. I glance over those from time to time.

I noticed a remark on one of them, before I started up here. The safety inspector on the Venice plant reported that one of the contractors was not placing his equipment back in the racks which had been provided for it, and was leaving shovels lying around where men could fall over them; and
that will be reported to this contractor, and he will have to 6548
be more careful.

In this particular case we are going beyond our own organization and seeing to it that the contractors' men shall not have any accidents.

Q. How are relays and protective devices tested and maintained? A. The relays and protective devices on the machines and switchboards are tested at frequent intervals by special crews engaged in this work continuously. This is a major bit of work. Some of the more important relays or automatic devices may be checked once a week; others may be
given routine tests at regular, but less frequent intervals. 6549

To give you an idea of the extent of this work, I should like to list for you just a few of the devices, to give you an idea of how extensive this is.

We have a regular maintenance schedule and testing

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schedule on 6,842 protective relays; 2,790 oil circuit breaker control devices; 695 regulating devices; 3,758 auxiliary control devices; 2,423 recording devices; 6 oscillographs; or a total of 16,514 devices that have to be regularly maintained,

inspected and tested, and require a good many men in continuous operation to do that.

But the correct operation of the system as a whole is a function of the accuracy with which some one of these details work, and in order to maintain a high degree of service reliability, it is not sufficient to have purchased and installed good equipment and put it even in the right location, but these little devices have to be in good operating condition or the whole system would not function as it should. The
6551 care with which this relay work and this maintenance work is done, is, in my opinion, a most important part of the operations.

Q. How are overhead lines and underground cables operated and maintained? A. The main transmission system is operated and maintained by three line divisions. These divisions are located at Rivermines, Keokuk and East St. Louis.

The Rivermines group work up on the Illinois side to handle those circuits. The Keokuk division is responsible for the operation and maintenance of the St. Louis-Keokuk line, which has been described. In addition, they take care

6552 —2,797—

of all the subtransmission lines in Iowa and Illinois north of Alton.

The Rivermines line division takes care of the operation and maintenance of all of the 132 kv. overhead lines.

The underground cables are maintained by the St. Louis underground division. That is a separate group not included in the other three.

To give you an example of one of these groups, the men working out of Rivermines use three cars; 7 light and 3 heavy trucks; and they have located at the Rivermines sta-

tion caterpillar equipment, and then there are three machines used by patrolmen located along the line. These patrolmen make regular inspection trips along the line, reporting every type of repair that they can observe, and those repairs are carried out by the line crews. In times of trouble those patrolmen act to help locate the place where the trouble is.

I would like to point out that we depend on the service from our Osage plant. We have four transmission lines available between the plant and the St. Louis plants, and the loss of any one of those does not cause us to lose any service, and 6554
the loss of two of them would, under nearly all conditions, not result in the loss of any service. The result is that we rely on that transmission line to the same extent that we would if the plant were in closer to town, and that means that we have to use an unusually high degree of maintenance

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and operating attention.

The list of items that comes in after one of these inspections would not only surprise you, but might amuse you, some of the tiniest little items. A loose nut, a single nut, will be mentioned, and the crew will have to get to that and 6555
tighten it. But those are the things that cause trouble if not taken care of.

On the underground cable system, that is handled as a different and separate operation. We have to distinguish in all of our work between different types of crews. An overhead crew is specifically skilled on that work, but they would not know how to do cable work, so you can't divide cable work as to location geographically. You couldn't put a group of cables here and a certain bunch of lines, and put them in charge of one crew.

6556 *Stanley Stokes—By Respondents—Direct*

So that the regular tests and cable work and repair is all handled by what is known as the underground crew, and their headquarters are at St. Louis. Once each year cable circuits are given insulation and electrolysis tests. During the hot summer months we make frequent temperature surveys, both in the ducts and in the manholes.

St. Louis, as I stated previously, has an extremely high ground temperature, and also has a ramification of railway circuits. Those two conditions have to be carefully coped

6557 with. First, we make, probably, more elaborate temperature

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surveys in the ground in the summer time than any company with which I am familiar. We place thermo-couples in the ducts, we have thermometers in the manholes, and we have to keep going over the system to be sure that no excessive temperatures exist.

On the electrolysis work, which is caused by stray currents which usually emanate from the railway systems, getting onto our cables, and then leaving at some point, at which point they damage the sheath, the electrolysis work

6558 has required potential surveys continuously for many years, in which we go around and measure these very small potentials that exist, and try to bond or ground these cable sheaths in such a way that no damage will be done.

I have stood in the basement of our Page Avenue sub station and seen as much as 6 or 8 hundred amperes coming in over the cable sheaths. That is leakage current from railways over the system; because our grounds are better and more extensive than the railway system, the current tends to flow from their system down to our ground, and it gets there via these cable sheaths. As long as we have them

properly bonded, and take them off at predetermined intervals, we can eliminate the damage.

There is also one other condition which require constant attention, and that is the chemical action which, in certain areas, operates to corrode the lead sheath. Lead is ordinarily

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regarded as almost immune to chemical action, but there is a peculiar combination in certain of the soils that does attract the sheath, and we have to neutralize the ducts in those areas so as to eliminate that difficulty. 6560

Q. Are overhead lines inspected regularly? A. They are. The inspections are carried on, as a rule, on the overhead lines—well, I should qualify that statement, overhead transmission lines—that is, the main lines are inspected at regular intervals and the crew at the time of inspection does not attempt to make a repair. They make a very detailed record of what they find, and that record is turned over to the superintendent of the repair work, and he assigns the repair crews to the work.

In certain other types of distribution work, we use the regular linemen, who make a combined inspection and repair 6561 at intervals, and where they find anything wrong, they fix it.

Q. Now that inspection requires climbing and other investigation, does it? A. It does. About once each month the patrolmen make inspection tours, examining structures, wires, insulators, and the condition of the right-of-way.

Once each year a climbing inspection is made, during which each structure is climbed. In that case the men go over the towers, and tighten the bolts while climbing the structures. All dirty insulators are cleaned. Frequently we have

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to remove the insulators and replace them with new ones,

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or with others that have been claimed, and bring them into the shop where we chemically clean them.

There are various things, though, that adhere to porcelain insulators in the East St. Louis district. I mention that particularly because it is a heavy industrial area there with chemical plants—it is the headquarters for the zinc industry in this country. They quote zinc as f. o. b. St. Louis. We have
6563 the National Zinc Company there, we have got a fertilizer company, a chemical company, and almost any other kind of a company; and when the combined products from all of those companies settle on an insulator, you may have to take it down and take it into your shop if you want to keep it clean.

We have found that we can clean them very rapidly with a form of chemical that we heat, just dip them in and it takes the refuse right off. We replace them with new ones on the line, and put those back in stock.

That is one of the methods that we have developed which
6564 has prevented a large number of serious outages.

Q. You have spoken of patrolmen who, in a sense, police these lines. Are they stationed at many points along the transmission lines? A. Yes. I didn't go into any detail as to their operations. We usually try to pick a patrolman who is married, and see that he is fixed up in a residence located at a strategic point along the system. A telephone will be

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placed in his home, and in addition to that, telephone booths will be located at intervals along the line.

There are certain points at which the patrolmen can always go and get in contact with one of our main stations, from which all forms of communication are available to the system load dispatcher. So that we have even gone so far that the transmission line superintendent has a radio receiver in his car, which will receive communications from the transmission line when the carrier current is in operation. These patrolmen have regular duties, to make regular patrols, in addition to which they are sent out on special
patrols and do minor maintenance work such as can be ac- 6566
complished by two of those men meeting at a point, and fixing up small repairs. If it is anything of any major consequence, they will call for help.

Right-of-way clearing and road maintenance, and other work requiring unskilled labor—the patrolman is authorized in such instance, within limits, to hire outside help, common labor, and he reports the work done and the hours worked. He also does some clearing at various times himself.

They report by telephone to the system operator at regular intervals each day, and submit daily written reports to
the line department. From these reports and those made at 6567
the time of the climbing inspections, maintenance work requiring line crews is scheduled, and the work carried out.

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Store houses are provided at intervals along these lines, and in those are stored tools and supply materials. We also locate, at certain points, spare poles, if it is a wood pole structure, and we carry certain spare tower parts in stock at Rivermines. We have discontinued, several years ago, the practice of trying to keep spare towers. The reason for that

is that there are so many types of towers, so many varieties, that you, no matter how many spares you had, probably wouldn't have the one that you needed, and it wouldn't be close to the point where you needed it. If it were the one you needed, and were right at the point where you needed it, you still couldn't use it, because our experience has shown that where a tower fails—and that is very, very rarely, once in a matter of maybe 20 years—the footings will be damaged, and you don't know to what extent, and you do not dare to use
6569 them. Consequently, your first maintenance emergency work is to put up a temporary wood pole structure, and restore service quickly. Once the service has been restored, you might just as well wait to get the rest of the tower while you are getting the few parts.

So, by some experience, we have decided that the maintenance of spare towers is not practical. I have experienced several tornadoes, and there have been one or two towers destroyed for other reasons over the 25 or 30 years, and in every case we restored service quickly by setting up temporary

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6570 wood pole structures, and rebuilt the towers later. So that is our present practice.

Q. In the proper maintenance of these lines, do you get the cooperation of landowners in the territory covered by the transmission line? A. We not only get the cooperation of the landowners, but we go farther than that. We know the methods that were used in the early days by right-of-way people, who would get rights-of-way on a contract basis, and then would not have to live with the lines afterward.

In the old days it wasn't uncommon for these right-of-way men to promise that immediately after the transmission line,

there would be an electric railway follow, and when the power company went out to maintain and operate this line, they met with a very cool reception. Well, we, having to live with these lines, see to it that from the time negotiations begin, to acquire rights-of-way, that no enemies are made.

If we can accommodate these farmers by letting them farm a little of the right-of-way, with crops that don't grow high enough to do any damage, it works out very well, and helps keep the weeds down, and keeps them satisfied.

So we start, from the time the contracts are first entered 6572 into for the right-of-way easements or purchase, and see to it that these contracts provide for some damages to fences, and any other type of damage, crop damage or anything, so

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that the first time that the wire stringing crew goes right through there with a caterpillar and goes through the fence, the farmer is satisfied that he will get paid for that, that there will be no loss there. He may even get a better fence. There is no trouble, and there is no more of this meeting you at the edge of the lot with a shotgun.

If we have easements where a transmission line is under 6573 construction, we recognize that the owner is entitled to complete his crop, and that that doesn't go with the easement. And we either see to it that he can, or pay him for it.

Now when it comes to operating the lines, these farmers are of great assistance to us. They report trouble. If a man sees a flash at some time, he will go to the phone and call in. If that turns out to be a case of trouble on our system, and has been of help to us, we will give him some form of nominal payment, anything from a dollar to ten dollars, depending

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on how much trouble he went to; and you would be surprised how much trouble they will go to for a dollar.

So it has proved to be very beneficial. We hire them also for right-of-way clearance. That is another point. A farmer at certain times of the year has no work that he can really do efficiently on the farm. At other times he has more than he can do. In the slack periods he is very glad to get a little extra money, and we hire him to do the right-of-way work.

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6575 Fence and creek crossings are provided, so that our regular patrolmen that have to go through regularly, can get along without damage and without delay.

Drainage ditches along the line are kept open to prevent flooding, and to prevent land erosion, and that is of assistance not only to ourselves but to the farmer. Roads and trails are maintained.

So that, in general, we make extra efforts to obtain the cooperation through these many miles of transmission line, because we have found by experience that it is profitable to do so, and an economy to the company.

6576 Q. In the construction of these lines, is it frequently necessary to cooperate with other utilities? A. Yes, we have to cooperate with the other power companies and telephone companies. That has become almost a routine procedure, and is carried out almost automatically. We both have the same requirements to meet for wire crossings, permits of all kinds, and there is very little, if any, difficulty in that particuar part of the work.

With the R. E. A. groups, they are not skilled in the art in all cases, and they have to make these wire crossings, and they have to make reports to commissions, and in general

their idea is to put these lines up and get all these little items straightened out later, and we have found that it is very beneficial to help them, and at little cost to ourselves,

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and for our own protection, by making wire crossing prints. If a wire line is going to cross under one of our transmission lines, we like to know that the clearances are going to be as stated, and also like to have a complete print and record of it, and grant this wire company a formal permit.

In order to do this, there is required a standardized print, engineering drawing, of the crossing, showing all clearances, giving a plant and elevation. We have made a number of those for some of the Illinois R. E. A. groups, and that has expedited both their work and saved ourselves considerable delay and annoyance, and they appreciate it. 6578

Q. How are the sub-transmission circuits operated and maintained? A. It is the duty of the overhead and underground divisions of the operating departments, located at various points throughout the Union Electric Group, to operate and maintain the distribution sub-stations, transmission sub-stations, and to carry on certain construction work. 6579

The operation includes inspection, switching, except in the plants or sub-stations; location of trouble; emergency minor repairs and replacements.

The maintenance includes the work requiring crews of men, and consists of pole and tower replacement.

Maintenance includes the clearing, cable repairs, replacement, and all other such work which is not classified as new

—2,808—

construction.

The major portion of the sub-transmission system was built by the Union Electric's own men, installed from time to time, and they maintain the system.

Q. Are maintenance groups distributed throughout the territory? A. They are. That is a matter of importance to see that these repair and maintenance groups are strategically located so that minimum delay is had in case they are called upon to handle any trouble work, and also to minimize their mileage, the mileage which they have to cover in their
6581 ordinary routine work.

The largest groups are located at Webster Groves, East St. Louis, and Alton, Illinois, and at Keokuk, Iowa.

To facilitate handling of the sub-transmission circuits, they have materials and supplies and equipment maintained at these locations in a quantity sufficient for any emergency which may arise. We have even had, as you recall in respect to our main transmission system, tornadoes, and we had ample material to repair the damage.

Q. And is it, or is it not, true that in the maintenance of the sub-transmission system as well, the testing of under-
6582 ground cable, and electrolytic testing, and dielectric testing is made? A. I fail to quite get the question.

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(The question was read by the reporter.)

The Witness: There is a joint coordination of all of this work. The general supervision heads up in the load dispatcher, and in the system operators, and they are in constant communication with all of the different sub-divided groups, and in the event that a line

were being maintained, and should be required suddenly for service due to the failure of some other facility, the load dispatcher, through his operators, can contact, through this communication equipment which has been described, this maintenance crew and get that line into service before it had been anticipated.

Those things are all necessary if we want to make the fullest use of our reserve facilities. The line would not have been taken out of service without the permission of the load dispatcher group, to begin with. The 6584
special telephone facilities are maintained between these operating groups and the load dispatcher and the system operators, and those facilities are in addition to the main telephone facilities which I have previously described.

These facilities also are employed in connection with the safety work, such as placing hold-off tags on equipment upon which work is to be done, and to restore the equipment to service.

Much time can be unnecessarily lost in taking a circuit out of service and getting it back again if 6585
communication and an orderly, systematic group of

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men have not been provided. We feel that we operate that feature very carefully.

The dielectric tests of underground cable are made with a high voltage Kenotron equipment. This is a vacuum tube high voltage device, which can produce around 150,000 volts of direct current, and we take the cable out of service and apply this voltage, and

gradually raise it until the test specifications which the cable is supposed to meet, have been reached. For example, take a 13,800-volt cable which is scheduled to be tested at 26,000 volts. This machine gradually raises the voltage to 26,000, and holds it there for a predetermined time. If the cable fails before we get to 26,000, that is what we wanted to know. It needed repairs.

So we have periodically tested all of our cables,
6587 and the results of these testings usually are confined
to the cable joints, they seem to depreciate, or maybe they never were made right in the early days. Wherever we can blow up a cable joint in tests, we feel that we have saved one failure in service. As soon as the cable fails in a test, we repair it completely and test it again, and when it finally will withstand this test, we know that it has withstood a voltage about twice as high as it will receive in service.

We have rather elaborate equipment for locating faults in cables. I won't go into that in particular
6588 detail, but we have a Wheatstone bridge, which is a
means of measuring resistance, and from that we

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locate the probable fault within a block or two. Then we go out with what is known as a Lundin fault analyzer, and having put an alternating current wave with a very saw-toothed type of wave on the cable, we just go along with this exploring coil of this Lundin analyzer, walk right along the top of the ground, and find the point at which the fault is located. We can get

that within a matter of feet, and then we know right where to go to work and pull out the damaged links.

Temperature surveys, I have previously mentioned, and also the chemical erosion and the electrolysis.

The Examiner: We will recess until 2 o'clock.

(Whereupon, at 12:35 o'clock p. m., a recess was taken until 2 o'clock p. m., of the same day.)

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6592 *Stanley Stokes—By Respondents—Direct*

Afternoon Session

(The hearing was resumed at 2 o'clock p. m.)

The Examiner: Let us resume.

Whereupon, Stanley Stokes resumed the stand and testified further as follows:

Direct Examination by Mr. Browning (Continued):

6593 Q. Just before the noon recess, Mr. Stokes, you had been describing the operation and maintenance of the transmissions systems. Could you now tell us briefly about the maintenance of the distribution system? A. Yes, the distribution system in the Union Electric group is under the jurisdiction of a distribution department in each operating division.

Distribution, as we classify it, is the operation, maintenance, and construction of the lower voltage distribution circuits. In most cases these are 2,300/4,000 volt circuits.

The necessity for close contact with this system, and

6594 the volume of work that is entitled in the distribution system, requires that each system have its own organization.

They all function in conjunction with the main organization in the city who supervises the general design and the major features. All of the organizations are on exactly the same general pattern, and I shall describe the St. Louis City

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Division which will, to a large extent, typify the other smaller ones.

The St. Louis distribution system was previously stated to represent about one-fourth of the investment in the system.

When I say "St. Louis distribution system" in this case, that is not altogether definitive. I should say the distribution system of the Union Electric group that represents about one-fourth of the total investment in the system. And it is readily observed that that must constitute a huge quantity of poles, wires, meters, transformers and other associated equipment.

All parts of the system, of all voltages, outside of the power plants—I am referring specifically now to the distribution system—are under the jurisdiction of a distribution division. The functions of the division include, first, design, engineering design, field surveys, estimating, and preparation of specifications are carried out by cooperative consultation with related departments such as the electrical power plants, and consulting electrical engineering departments. By that I mean to convey that the distribution department does their own specific engineering and does not require advice on the day-to-day functioning of either design, maintenance, or operation, but that frequently the problem in the distribution department overlaps and extends into other divisions, in which case they are required to consult with the other departments and obtain advice.

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A simple illustration of that is a cable from a power plant to a sub-station is in the sub-transmission group as we have defined it, and yet, because the distribution department has the cable men under their supervision, they would install that cable and install the duct and they would repair it if it got in trouble. That is because it is necessary to maintain a large cable department in the distribution system, and we

do not duplicate it for the sub-transmission system, that is the cable group is really the same.

So that if a cable were to be installed, one end of it at the power plant involves an oil switch and a transformer, the other end involves a transformer and a sub-station. The sub-station involves outgoing distribution feeders. It is obvious, therefore, that if additional facilities are required at a sub-station, that the responsibilities and authorities of at least three departments would become involved. In other words,
6599 whenever a facility has to be added or changed that extends beyond the distribution system, they sometimes do not have full responsibility for that. But they do do all of their own engineering, design and operation within the strict scope of the distribution department and may extend, by joint operation with other departments, into some of the other work.

Construction involves the installation of overhead circuits on pole lines, underground cables, in conduits, or buried

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direct in the ground with proper protection; submarine cables laid across the Mississippi River for sub-transmission and
6600 supply circuits to the distribution stations.

Operation involves emergency repairs, switching of circuits, switching out of circuits for reserve or for repair work; and the handling of circuits in emergency.

Operations also involve meter testing and periodic surveys of voltage conditions.

At this point I wish to explain that the same functions have to be performed in the distribution system as occur in the sub-transmission system, such as voltage surveys, corrosion of cable sheaths, electrolysis, and such matters.

When I discuss these items which have been previously touched on in the other divisions, I shall attempt to be as brief as possible.

In the operations—the meter testing, as such, which is strictly a part of the distribution department operation, is carried out in the meter division, which itself is under the supervision of the power plants department.

As previously discussed, the sub-transmission circuits are handled and operated under the direction of the system load dispatcher, but the distribution department is directly in- 6602
volved in many of these operations, and it keeps in close touch with the load dispatcher.

Maintenance of the distribution system involves the re-

—2,816—

placement or repair of all parts of the system for whose operation that department is responsible. That is largely poles, wires, cables, conduits, services and many other items.

In the district outside of St. Louis, outside of the St. Louis area, these same functions are carried on but are in many instances combined with some other group for economy
reasons. 6603

In St. Louis County, the operation of the distribution system is carried on in conjunction with the operation of the St. Louis County Gas Company. That company was mentioned only once, I believe, at the beginning of this hearing, and described.

The St. Louis County Gas Company——

Q. (interposing) I don't believe we need to go into the gas company at this time. A. I merely intended to mention that they worked with the distribution department and to that extent were a little different than the city group.

In the Iowa Union Electric Company, the operations up there are carried on as economically as possible in conjunction with their local requirements for that gas company in that district.

And in every respect they attempt to utilize their facilities to the greatest advantage in the interests of economy.

Q. Is the organization set up functionally? A. Yes, the

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organization is set up for a functional division of responsi-
6605 bility, under a superintendent of electrical distribution in each operating department. A distribution engineer is in charge of design; a construction superintendent for each major unit provides a specialized expert in each field. A cable superintendent operates for the underground cable construction and maintenance; a conduit superintendent for excavations and subway construction; an installation superintendent for all construction and maintenance facilities on customers' premises, including meters; and an overhead superintendent for each major unit of the system, for the erection of poles, stringing of wire, including the maintenance of
6606 these properties to a predetermined reliable standard; an operating superintendent, in charge of trouble service, patrols, inspection, and testing of distribution equipment, surveys of many conditions, some of which have been mentioned, such as voltage, electrolysis, cable temperatures, and all other activities not involving permanent construction or maintenance.

In this category we mentioned voltage surveys. That has not previously been discussed at length because it is primarily a function of the distribution department to ascer-

tain that all of their customers are receiving suitable and proper voltage. In order to do so, periodic voltage surveys are carried on. By "voltage survey" I mean a considerable number of volt meters are set at various points on a feeder to determine the variation of voltage from the sub-station

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clear to the end of the feeder, and to see what voltage typical customers are obtaining. We have to watch the high voltage in close to the sub-station, at times of light loads, and low
voltage at the extreme end of the circuit at times of heavy 6608
load, and to see that this variation is not greater than the prescribed limit.

A chief clerk supervises the performance of all of the clerical functions which can be reduced to a routine.

The superintendent of records maintains the system diagram, plat records of all properties, has charge of the permit and easement files and directs a limited amount of drafting work for the department.

In St. Louis County, the general handling of the distribution system is very similar.

In the distribution department there are a large number 6609
of employees. It is one of the largest single divisions of the entire company. I won't attempt to go into particular details with respect to these employees, but I would like to mention just a few of the types, and I will illustrate the number of men.

Supervisors in St. Louis city—there are 12; in St. Louis County and outlying plants—9; in Illinois, 7; in Iowa—2. In all there are 30 supervisors.

In a similar manner there are 34 engineers, 28 estimators

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But inasmuch as the purchasing department is carrying on the complete functions from the time the order is placed, until the material is received, we send this man there under their direction, and the whole process is therefore kept in

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one group, and under one general control. It is working out very nicely.

As an example of some of these facilities, recent emergency requirements of wire for both Iowa Union Electric
6815 Company and the St. Louis & Belleville Electric Railway Company, were obtained to their advantage, largely due to the broader contacts which the electrical buyer is able to maintain by virtue of the large volume of these products purchased for the group. Also, in the construction of a new freight office building for the St. Louis & Belleville Electric Railway Company, the department functioned not only to obtain the best bid, but also to assist the railway company materially in analyzing the proposals, together with the ability of the various contractors to best meet the requirements of the user. In other words, the Belleville Company
6816 makes very few contracts, that will be the only one of that kind that it will make for the year. And the larger group are making contracts right along, and they know the ability of these various contractors to do the work.

The department functioned to be of assistance to the Union Electric Company of Illinois in the shipment of some large transformers which were urgently required. The traffic clerks' handling of transportation and expediting, resulted in a net saving of one week's time in getting the equipment into service.

—2,898—

This transportation problem required specialized handling because of certain clearance difficulties. They were too big to be shipped by ordinary route and by making a careful study, they saved that much time.

The availability of engineering buyers has been mentioned and that again is of considerable importance. I won't stress that any further, but we have made three trips back to the factory for the purchasing department in the last six months, and in each case picked up a number of changes required in the equipment just before shipment, any 6818
one of which would have more than paid the cost of these trips.

It has the further advantage that the engineer who sees the equipment at the plant all assembled is in position to assist the local construction forces when it is received.

Some of this new equipment, particularly in air circuit breakers, has changed in its complexion so rapidly that the man who hasn't put in any for a year, doesn't recognize the stuff when he sees it. I mean the previous switches which he would have received would be oil circuit breakers.

Q. Does the operation of a centralized purchasing department result in obtaining low unit prices? A. These activities, such as those cited, do result in low prices. The most obvious are reductions brought about by the purchasing of larger quantities with larger discounts, the coordination of standards, not only as between the various operating units, 6819

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but with industry standards, and manufacturing standards, which contributes to lower prices by the avoidance of special runs, as well as by taking advantage of increased quantities.

The broader contacts of a specialized buying group permit more intelligent appraisal of price levels, and a better timing of purchases, all of which contribute to lower first cost.

I would like to cite just a few examples, and make it as brief as I can, of this type of economy.

Take line wire, and service cable. Normal requirements of line wire for the Iowa Union Electric Company will run only about 25,000 pounds annually. Purchasing in a central-
6821 ized department takes advantage of better market timing, and based on quantities which are never less than 100,000 pounds, results in marked savings to that subsidiary.

In connection with the recent change-over from 25 to 60 cycles at Fort Madison, the Iowa Union Electric Company required 143,000 pounds of bare and weather-proof wire, which were furnished on contracts made by Union Electric of Missouri, prior to and in anticipation of the market rise in the fall of 1939. These contracts were made with copper at $10\frac{1}{2}$ cents, which wire, when released to them, was taken with copper at $11\frac{1}{4}$ cents, and resulted in a saving
6822 from three-quarters to one cent a pound.

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The same is true of Union Electric Company of Illinois, and to a lesser degree of the Lakeside Light & Power Company.

The requirements of service cable for these subsidiaries follow much the same pattern. Unit prices that they would obtain, being based on a minmum of 50,000 feet on centralized purchasing, whereas their possible maximum would only be 10,000 feet in any one order.

Heavy underground cables for the transmission system, and special rubber insulated cables, are used largely in the St. Louis metropolitan area. However, such cables are occasionally required by Union Electric of Illinois, and frequently by some other subsidiaries, such as Union Colliery Company, and the St. Louis and Belleville Railway Company. For example, Union Colliery Company uses large quantities of rubber insulated machinery cable. In the last few months, we purchased, from the centralized division, 15,000 feet of this cable at substantial savings. 6824

A recent order for transmission cable for Union Electric Company of Illinois amounting to approximately $100,000, was bought at 6 per cent. below the level which would have been paid by them had it not been grouped with the other contracts.

On watt-hour meters, a quantity discount of 6 per cent. is obtained due to the large quantity which the Union Electric Company buys. It is doubtful if any of the subsidiary companies could earn any quantity discounts at all, with the

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possible exception of Union Electric Company of Illinois, which would earn a maximum of 3 per cent.

The purchase of line hardware, and line specialties, in the quantities involved for the whole group, is consistently made at price levels ranging from 5 per cent. to 15 per cent. under comparable prices if each individual unit were to make its own purchases.

Q. I think you have illustrated sufficiently the point you were making.

In the operations department, is it necessary to employ a salvage salesman to dispose of salvaged material? A. Yes, the purchasing department employs a full-time salvage salesman. That is really a pretty good sized business, and he sells everything from the scrap materials to machinery. When you finish a large job, you don't try to carry over machinery for many years, you sell it and buy it again if you need it. So that when the Osage project was completed, there was a large amount of machinery on hand which had
6827 to be disposed of, and as a regular process we burn the insulation off of old wire and strip the lead off of cables, and reduce it to scrap copper or scrap lead, or scrap of other kinds. We do some salvage too, in which some of that stuff which is in pretty good condition is repaired and put back into service.

The subsidiaries' scrap are all accumulated into the cen-

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tral warehouse, and all handled at one time. We get from half a cent to a cent a pound more by getting it all in one group that way, than the small companies would for their
6828 small quantities.

The Examiner: Let us have a short recess.

(Whereupon, a short recess was taken, after which the hearing was resumed.)

The Examiner: Let us resume.

The Witness: I merely want to illustrate the magnitude of the scrap transactions. A single transaction recently involved the sale of over a million and a quarter pounds of accumulated scrap wire, and the

other surplus in scrap represents about $40,000 a year, or something on that order of magnitude.

By Mr. Hamilton:

Q. Does the operation of the department involve the study of the applicability of various sales tax statutes? A. Yes, the matter of properly contracting for, delivering and applying equipment, requires, these days, that some reasonable study be given to the matter of sales taxes and other features. This is something of importance. For example, 6830
one individual purchase transaction made during the past several months has involved the question as to the proper applicability of taxes in amounts ranging from $2,000 on one item to $27,000 on another. In other words, by a certain

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process of buying and shipping, you can resolve what appears to be an interstate commerce transaction into a mere intrastate transaction, in which the combination of circumstances might require you to pay sales taxes, and if the same transaction is handled in some other manner, only slightly different, it does not require you to pay any. 6831

Q. Without going into detail, will you give us very briefly the general pattern of the operation in your warehouses and storerooms, which I understand from your previous testimony—in which you have to some extent located the physical facilities—is an item of substantial importance in the operations of the system? A. Yes, the various store rooms and the handling of material are one of the major items of the company's business. I am trying to condense and reduce my remarks on this, to a very minimum, but I

must mention the central stores office, which is a clearing house and a control center for all the stores operations, and there is where the general stock records are kept, and the headquarters of the general storekeeper and his assistants. It is a pretty large department. I know there are some 35 or 40 clerks there in the one room, just by observation, and the utility shops and other facilities there.

The particular location of this general storeroom is at 19th and Gratiot Streets, and at that point they have just

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recently constructed another large material handling area, with modern facilities.

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In addition to the stock record, it is the function of this office to see that the minimum quantities of stock are at all times on hand, and replenish the stocks as fast as the minima are reached, and to see to it that the previously set maximum amounts are not exceeded.

Q. You might give us, if you will, the number of em-
6834 ployes who devote their time to this particular phase of operation, and also the extent of the transactions handled. A. There are six store rooms located at six of the power plants, and quite a number of other individual points at which material is distributed, in addition to which this same stores department serves the properties in both Missouri and Illinois.

The number of employes for the past year, or at some point toward the end of the year, amounted to 181 at the time this count was made..

They include two employes at the store room of the Mississippi Power Company and one at the Iowa Union Electric Company.

In the operation of the stores department facilities, some 20,000 different items of material are stock, the average value being about two million. About 350,000 items are received, and 760,000 disbursed annually. The approximate value of the net annual issues of material is three and one-half million dollars.

Excluding fuel and other items which do not pass through 6836
the accounts of the stores department, 325 railroad cars of materials are unloaded annually, and a further large quantity of materials received by truck. Twenty hundred tons

—2,906—

of scrap material are shipped annually.

Q. Now, very briefly, the major objections of this particular department. A. Well, the first objective in any stores department, and certainly in this one, is to render adequate service to the various company divisions, so that they get the material they need when they need it, and to have available adequate personnel and adequate transportation equipment 6837
to get the material on the job when emergencies occur.

I could describe several examples of that particular case, including two tornadoes, and the general object there is to keep the structures and the yards properly equipped to do a big job when necessary, and to do the regular job efficiently.

The second objective is to do the things that are required as economically as possible.

For example, at the Cahokia plant all materials required are delivered by store employes direct to the location where

needed. This gets the material to the job faster, and is more economical, because it eliminates the time of mechanics making frequent trips to the store room.

For example, it is about a half a mile if you go the length of that plant and back, with a piece of material, and for a high-priced electrical employe to make such a trip consumes considerable time, particularly if he does it on foot, which he would.

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6839 The store room, which is located in the yard near the power plant at Cahokia, has little—what are generally referred to as scooter cars—and they come over to the main plant with ordinary supplies of bolts, nuts, and so forth, go right into the elevators, go up to the sixth floor, and right out in front of the boilers, wherever it is, and deliver the material right to the place where it is needed.

That can be done in a fraction of the time that used to be required when they let the employe go and get his own material from the store room.

6840 Mechanical handling of equipment is used almost throughout our whole system. We have all forms of mechanical handling devices. By that I mean such things as a stacker. That is a little electric truck that runs in and goes under the box, or whatever it is, and elevates it, and stacks it up on all of the other boxes. All of the stores material of the heavy type is mounted on raised platforms, raised so that this equipment can run under it, pick it up and take it wherever it is wanted, and set it down again without the necessity of a man having to lift it.

The possibility of accidents in handling materials is quite great, and the stores department is particularly active in its safety work.

Q. Now, is the work of this particular department coordinated as among the various companies in the group?

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A. It is, completely coordinated. The fact is that it serves the various companies just as though it were one operating unit. In fact, I expect if you were to ask some of the employes of the stores department, I doubt if they know that in 6842
some of these cases they are working for separate subsidiary companies. That is, they treat the material delivered to the Illinois-Cahokia plant just the same as they do to the store room in St. Louis County, which supplies the gas company.

The unified stores system has materially reduced the cost per unit of handling equipment and materials.

It is a big economy in the floor space, which after all is expensive in these warehouses, to operate them jointly for the whole group, because if each one has its own store room location, in many instances they would be in the same location 6843
that the joint one is now.

For example, I think of the St. Louis County Division; they have a store room near our Page Avenue sub-station. I know the electrical department would have to have one at that point, and the gas department would need one in that immediate vicinity. And the single store room handles both equally well.

Q. What do you regard as the criteria of a high-quality electric service? A. I should define high-quality electric service as primarily constituted of three factors, first, con-

tinuity of service; second, voltage regulation; and third, the frequency control or regulation.

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In comparing those three as to importance, I should say that—it is a little difficult to state which is the most important because if any one of them were fully lacking you would have no service, and all of them have to be supplied and have to be the best available if we are going to have a resultant high-quality service.

6845 To state specifically and grade electric service is a rather difficult matter, but to obtain a relative idea of a very high-grade service, as compared with a slightly lower grade, is not difficult.

Q. Now, if you will, discuss each of these criteria as applied specifically to the Union Electric Group. A. In the Union Electric Group, the effort has been made consistently for years to each year improve the grade of service rendered. We also have to keep in mind at all times the value delivered to our customers per dollar, and the co-ordination of those requirements to give the customer the most for his money is

6846 the ultimate objective.

Now, discussing the service feature, I should say that if I had to place the greatest value on any one, I would say that continuity of service was the most important. The degree to which service is continuously available is a measure of its quality. The continuous service or nearly continuous service is to be had only as a combination of a number of factors,

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among which may be mentioned the suitable design carried out under the direction of competent engineers, the most reliable apparatus obtainable, and the duplication of facilities

where required, so that in the event one method of supply fails, another is available to take its place, and last, but not least, adequate operating forces supplied with proper equipment and under the direction of experienced and highly skilled supervisors.

The fact that this group of companies has a long record
of highly continuous service is a result of the conscientious
adherence to these principles. In the description of the prop-
erty we have previously discussed the fact that all of the
power plants were closely interconnected by duplicated main 6848
transmission service, also that the subtransmission system
always had another cable to take the place of the one that
might be in trouble, and that the transformer banks at the
substations and power plants were duplicated.

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In describing the power plants themselves, we showed how the buses were duplicated and how facilities had been provided to transfer turbines from one bus to another, and similarly for feeders and associated equipment.

I am going to make this comparison of these facilities 6849
just as brief as I can to bring out the point which I am
trying to make, namely that all of this equipment has to
be provided and suitably designed and coordinated if con-
tinuous service is going to be available.

We then, after describing the equipment itself, described the operating forces and their facilities, and their strategic location of warehouses and other facilities and transportation equipment to maintain the service and to restore it as quickly as possible.

Our operating forces are highly paid, experienced men with, on the average, a long record of service with this particular group of companies. The result of the coordination of all of these facilities is that the Union Electric Group renders what in my opinion can be stated definitely to be high quality service.

Not since 1907 in the early days of the electric light and power industry has this system sustained a complete shutdown. At that time the entire district was served by a single
6851 steam plant in St. Louis. Trouble there shut down the entire plant and caused the complete interruption of service for a number of hours. Such a situation would be hard to conceive under the present unified system of interconnected

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generating stations.

Now, in attempting to describe continuous service, it is a little difficult to get exact bases for such description. I attempted to make an analysis of the seven months from April to September, 1940, to determine at the present time what the probable percentage of continuous service that a
6852 customer of the Union Electric Group might anticipate would be.

The calculations for that particular period which were based on a customer outage probability of once in 4.22 years worked out, on the calculating machine, to indicate that the customer has trouble-free service, that is, he has continuous service, for 99.99729 per cent. of the time. I tried the same thing for year ending September 27, 1929, and at that time the customer had an average outage once in every 1.39 years, which gave him a percentage of 99.99179. Now it is obvi-

ously difficult to discuss percentages of that type, and a more satisfactory approach is to analyze the interruptions to service and to indicate improvement by giving the reduction in the number of interruptions.

This method consists in describing the bad part of your service when you are attempting to state that it is good service, and is a little bit awkward, but seems to be the only suitable method.

Q. If I may interrupt you just a moment, you used a figure in your testimony of one customer outage in something 6854
like 4-plus years. Is that the present record of performance?

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A. Yes. I stated that,—or I meant to indicate that it was the experience in the seven months ending with September of 1940, which period we have just analyzed; and the other figure of one in every 1.39 years reached back to 1929.

The object there was to indicate improvement in the service in that interval of time.

A similar situation exists when one discusses transformers themselves. A large power transformer may run 99.15 per cent. efficient, leaving only .85 per cent. for all 6855
losses. So when such equipment is being analyzed and attempts made to determine what the nature of the losses are, we usually describe the losses, such as iron loss and copper loss, and not the transformer efficiency as a whole. But in so doing it should be kept in mind that we are devoting our attention to the .85 per cent. and expanding it, and not to the 99.15 per cent.

Now discussing some of the major interruptions in the last 33 years, since that period in 1907 when we lost the

total load on the system and which has not occurred since, I have examined the records and have picked out what appear to me to be cases of severe general system disturbance, that is not located with respect to just one feeder or one customer, but outages which affected the whole system for a period of time long enough to be measured and to be appreciable.

There were 15 such cases in the 33 years. The greatest

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6857 duration of any of those cases was brought about by the tornado which St. Louis suffered in Sepetmber of 1927. This storm severely damaged our Venice power plant and destroyed the Venice sub-station. Since the greater part of our city transmission system is underground, areas other than struck by the tornado were only affected for a moderate length of time.

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In the tornado area itself, we did not have all service completely restored for about 5 days, but in most cases, service was made available as quickly as the customers were in
6858 position to use it.

The largest single loss of load in the period of 33 years resulted from a difficulty in attempting to synchronize No. 5 generator at Cahokia on September 3, 1931. This resulted in a temporary loss of 97,000 kilowatts of load, most of which was almost immediately restored, and the remainder completely restored within 34 minutes after the occurrence of the interruption.

I attempted to arrive at some other basis for the accumulated effect of these major outages, and although this has to

be given as a very rough approximation, I totalled up the production of the kilowatts stated to be lost, and the time during which it was stated to be out, and added those figures together. With the exception of the tornado outage, I concluded about three-quarters of a million kilowatt hours should represent the approximate total duration of outage for the period.

Q. What period is that? A. That is the period from 1907 to date, and was occasioned by these major outages. That, placed on a percentage basis, is very small. I didn't attempt 6860
to do that, but to illustrate, we expect to have a send-out for the year 1940, approximating 3 billion kilowatt hours, and

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three-quarters of a million would be a very small percentage of the one year's send-out alone, not to mention the previous 32 years. So it is obvious that the customer gets continuous service.

Q. You have also spoken of good voltage regulation as being another test of high quality service. Does the Union Electric group maintain good voltage regulation? A. I think 6861
I can say that Union Electric group makes more than an ordinary effort to maintain good voltage regulation. I stressed that in some of my previous testimony with respect to the amount of special equipment which we have available for that purpose, with particular reference to load ratio control transformers. Those are a type of main power transformer which handles tansmission lines, and is so designed that step regulators can step the ratio of transformation up and down while the transformer is in operation.

Also synchronous condensers and other associated equipment are in extensive use on our property, and I believe in more than the customary amount.

These features, together with the fact that practically all of our distribution feeders are equipped with the highest type of voltage regulating equipment, are all conducive to good voltage regulation. The fact that the voltage is good at the customer's premises, is not left to chance, but is determined by voltage surveys.

6863 —2,917—

Our voltage level itself, that is the lamp voltage level, whether 115 volts or 120, is carried at the most approved value, as measured by recent standards, and the voltage variation at the customer's premises is kept within close limits.

Q. Has the Union Electric group been successful in maintaining close frequency regulation? A. We have no difficulty in maintaining good frequency regulation on our system. We have no particularly severe types of load to handle, which represent a major portion of our load. By that I mean, for example a most severe load to carry would be that of a
6864 big steel mill, if it represented a large percentage of the system. We have one or two such loads, but they are not a big percentage of our total capacity.

The governor performance is constantly being observed and studied and at the present time our frequency regulation is sufficiently good, in fact better, than the requirements of any of our customers, and our chief object today is to acquire and improve our governors so that in the future, when new processes may be developed that require closer regulation, we will be in position to provide it without undue expense.

By increased requirements for closer regulation, I have in mind primarily future interconnections or any type of connection which requires that different parts of the system be maintained in synchronism with themselves, or with other systems, without unnecessarily transferring load. Surging is a good way to express it. The question that arises

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in this connection is as to whether these requirements for precise frequency control are really a provision for the customer or whether they are not primarily a function opera- 6866
tion of the system itself.

In any event, the complaint on frequency, I believe almost never arises—I don't recall any myself in our district.

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Mr. Hamilton: Will the reporter please mark this diagram as Respondents' Exhibit No. 55 for identification?

(Respondents' Exhibit 55 was marked for identification.)

By Mr. Hamilton: 6867

Q. Please explain what Respondents' Exhibit No. 55 for identification represents? A. This represents what is known as an oscillogram. It is a photostatic copy of the actual film record which is obtained from an electrical device known as an oscillograph. In this particular case this instrument is an automatic oscillograph.

Q. What are the two instances shown on the record in the chart? Are these instances of trouble that have been recorded on the oscillograph? A. Yes, they are.

Q. Before attempting to describe it generally, I would like to offer this in evidence, and I simply want you to state whether this is a true and correct record of the particular instances which the diagram purports to represent in so far as you are able to make that statement? A. This is. This is an actual photographic copy of an instance which occurred in operation, illustrating a typical type of trouble, and the analysis thereof.

Q. The facts shown are taken from the records of the

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Union Electric Group? A. They are, they are taken from the records of our department which handles cases of transmission line trouble of this type.

Mr. Hamilton: I offer the diagram in evidence as Respondents' Exhibit No. 55.

Mr. Odell: No objection.

The Examiner: It is so admitted under the number mentioned.

(Respondents' Exhibit No. 55 was received in

6870 evidence.)

By Mr. Hamilton:

Q. Will you refer to the various abbreviations appearing in the left-hand column of the exhibit, Exhibit No. 55, and explain their meaning? A. The first abbreviation there with the figure "1" and the Greek letter "Phi", refers to phase No. 1, and you read it phase No. 1 to neutral volts, meaning that the wavy line on the top of the chart is an indication of the voltage between phase No. 1 and ground, or neutral, the neutral being grounded.

The next abbreviation below that indicated as "Ven. Page No. 1 Grd. Cur." refers to Venice-Page circuit No. 1, and the wavy line shown is a measure of the current to ground in that circuit during a fault condition.

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The next abbreviation, "Cah. Ven. No. 1. Grd. Cur." refers to Cahokia-Venice, Line No. 1, ground current, the current itself being indicated again by the oscillogram.

Q. In order to shorten your statement, will you merely read, without abbreviations, the balance of the detail shown 6872
in the left-hand column? A. The next line below is Cahokia-Venice No. 2 circuit, ground current.

Incidentally, these Cahokia-Venice circuits are the 66 kv. tie-lines between the Cahokia plant and the Venice plant, which were referred to many times in our previous discussion.

The next statement below in the left-hand column is Bus Tie, Ground Current.

The next one below that is Venice-Stallings No. 1 circuit, ground current. The Venice-Stallings circuit is one of the 66,000-volt steel tower transmission lines leaving the Venice 6873
plant, and supplying service to the Illinois-Iowa Power Company.

On the same side of the chart and further down we read North Bus Potential, phase 1 to phase 2.

Below that, Cahokia-Rivermines, circuit No. 1.

Below that, Cahokia-Belleville, circuit No. 1.

Below that, Cahokia-Rivermines, circuit No. 2.

Below that, Cahokia transformer banks Nos. 1 and 2.

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At the bottom, South Bus Potential, phase 2 to phase 3.

Q. Now state, if you will, what the oscillograph is, what it does, and what the significance of this particular collection of lines shown is, as related to the operation of your system? A. An oscillograph itself is not a very recent de-

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vice, it has been used in various forms for many years to obtain a photographic record of a varying current.

The application of the automatic oscillograph, which is
6875 left in continuous contact with the main transmission circuit or power plant, is a relatively recent idea, and with the intention of improving our service by obtaining more knowledge of what took place, when an outage occurred, we installed one of these devices. They are relatively expensive. I think they cost on the order of $3,000. As the results of the first one were so very good, and we learned so much about the operation of our relays and switches, we gradually extended them until we now have eight, at the major points on the system where switching occurs.

The automatic oscillograph gets into operation within
6876 less than a half cycle after trouble occurs on the line. In other words, it gets into operation within 1/150 of a second, and from there on it records all the operations which take place in a very short interval of time.

On this particular chart, all the trouble is over and the system has been restored to normal by the time you read from left to right through the numbers at the bottom of the dark part of the chart, and get to No. 5. In other words, that is about three inches of the chart there, and the system service is back to normal and the total elapsed time up to

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No. 5 is 16 cycles, or 16/60 of a second, in which all of these

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things have taken place.

Now, there is no other known way of determining, in a case of this kind, what really happened, and I should like to describe a case of trouble to which this refers, and outline how we were able to improve the service by reason of the knowledge obtained.

In this particular case there was a circuit interruption on the Cahokia-Venice No. 1 line on December 14, 1937. That 6878
line, while carrying 58,000 kilowatts of load, relayed at Cahokia and Venice, at 6:14 p. m. the circuit was cleared rapidly at both ends by balanced type relays known as the RDC type. These are what are called phase balance relays, in which the current in one phase is balanced against the current in another phase. The number of this particular relay was No. 3 Group.

No load was lost since the No. 2 circuit, that is the parallel circuit, immediately picked up all loads with slight disturbance to the system.

6879
At 7:50 p. m., the patrol crews reported the ground wire on No. 1 circuit had come down between Towers 4 and 5 within one mile from Cahokia. At 10:35 p. m., the broken wire was cut out, the hanging ends tied up temporarily, the circuit closed at Cahokia and Venice, restoring the system to normal.

Keep in mind that there was no load lost during this operation.

—2,925—

The oscillograph records from Cahokia and Venice show that the No. 3 phase, which is the bottom wire on the tower, only, was involved with the ground wire. This would indicate that the ground wire broke and fell and contacted the bottom conductor as it went down. Inspection made on a portion of the conductor showed the outer strands to be broken in numerous places, which indicated that the ground wire had broken from mechanical reasons.

Copies of the oscillograph record from Cahokia and
6881 Venice showed that the line cleared at Cahokia in slightly less than five cycles, .078 of a second, and at Venice, one cycle later. The total ground current at the fault attained a maximum value of 10,200 amperes, which is equivalent to 1,160,000 k. v. a., three phase.

It is of interest to note that the fault in this instance was of greater magnitude than any other previously recorded.

Now, to describe the oscillogram itself, if we examine the condition marked No. 1 along the bottom of the dark part of the chart, and refer to the typewritten matter on the right hand side, near the top, you will observe that at Condition 1,
6882 which is $2\frac{1}{2}$ cycles from the start of the chart, and you read this chart from left to right, starting at the left hand edge and measuring from one of the little wavy points to the next one is a cycle, or from the middle of one to the middle of the next one is a cycle, that is, until you get to the same position

—2,926—

in the current wave from one to the next—then you have completed a cycle. If you started at the top, you would simply go to the next top, or if you started in the middle, you would go to the bottom, back to the top, and then down to the middle again.

So in Condition No. 1 we have completed $2\frac{1}{2}$ cycles from the beginning of the disturbance, and at that point the current and voltage use are stated in the table just below in the middle of the right hand side.

—2,927—

For example, the voltage from the phase No. 1 to neutral or ground, which is the same thing in this case, was 36,750 volts, at condition No. 1. That is, at that instant. A little later, at condition No. 3, which is $5\frac{1}{2}$ cycles from the begin- 6884
ning of the chart, the voltage has risen to 37,700, and by condition No. 5, by that time, which is 16 cycles later, full voltage is again on the system. That 40,300 volts represents the full voltage from phase to ground on a 66 or 69 kv. system. I should explain that this 66-kv. represents the voltage between wires, and from the neutral or mid point of a 66,000-volt triangle, the voltage measured to either leg from the center would be 40,000 volts, which is arrived at by taking 66,000 volts and dividing it by the square root of 3.

Now, at condition No. 3, which was 4.25 cycles from the start of the disturbance, the Cahokia-Venice No. 1 circuit 6885
was cleared by the oil switch at Cahokia. That is very rapid clearance to clear the circuit in 4.25 cycles. By condition No. 4, which was $6\frac{1}{4}$ cycles from the beginning, the Cahokia-Venice No. 1 line cleared at Venice.

So you will observe by looking at these various amperes which I shall read from this chart that Venice-Page No. 1 circuit had, at $2\frac{1}{2}$ cycles after the start, 1,173 amperes to ground which decreased to 913 at condition 3, which is $5\frac{1}{2}$ cycles from the beginning, and went to zero. In other words,

the circuit cleared before we got to the next checking point which was condition No. 5.

—2,928—

In a similar manner, the other currents can all be observed from the table showing that in one case the Cahokia-Venice No. 2 current supplied from that circuit built up to 2,430 amperes at about $5\frac{1}{2}$ cycles from the beginning.

If you look at the wavy lines on the chart, I should explain that the height of those lines above the center of the
6887 axis is proportional to either the voltage or current, and we have constants that permit us to measure that. When the line opposite Venice-Page No. 1 ground current, as shown on the left, becomes a straight line and ceases to have any wiggle, then that means that the current has gone to zero, and you will notice just before it cleared that the current rose to a very high value.

Now, the net result of this thing, without going into a further detail, is that at the top of this chart we have the complete record of everything that took place at Venice, and in a similar manner, the lighter part of the chart below
6888 is the record of everything that took place at Cahokia on these circuits, with respect to the switching, and we know that the Cahokia switch is cleared first in $4\frac{1}{2}$ cycles, and that the Venice in $6\frac{1}{4}$, and we know what value of ground currents and short circuits we have to deal with.

For example, we can state from this record that the short circuit was 1,160,000 k. v. a., which would make it questionable as to whether we could count on 1,000,000 k. v. a. switches or breakers. In our new plant we are actually

—2,929—

installing $1\frac{1}{2}$ million k. v. a. breakers.

The conclusion to be drawn from this thing is simply this, that during a period of less than 1/10 of a second, there were a large number of operations which took place, and before we had this type of instrument we had no more idea, we had no idea whatever, as to which one took place, or whether they cleared as they should or not, and this permits us to check the performance of our relays, our switches, and in general is the thing that permits intelligent maintenance and operation of the equipment.

I should explain that in this instrument there are a number of different elements, each is a little individual mirror which operates when the current itself is thrown into the instrument, and that mirror moves a beam of light, which produces this wavy line on the film, and each of these little elements can be connected into any circuit when desired, and although we show the current for Venice-Stallings No. 1, it wasn't in trouble and nothing happened. That is the bottom line on the top part of the chart. It was zero all the way. There was nothing going on, but the oscillograph was connected in that circuit. 6890

It also tells us that the No. 2 Venice-Cahokia line, which fed into this same short by reason of the fact that the phases are connected at both Venice and Cahokia, so that any fault 6891

—2,930—

on No. 1 line would be fed from each end of itself, and each end would also be fed from the corresponding line, and if you will look down at the bottom chart, you can see that the Cahokia transformer banks fed in at condition No. 1, 7,870 amperes, and that the bus tie at Venice, at condition No. 3, transferred 3,360 amperes into the fault.

—2,931—

That I believe is taken to illustrate the application of these instruments, and in turn illustrate the fact that we are making every effort to improve our system operation.

Q. Did I understand you to say that the particular disturbance recorded did not result in an interruption of service? A. None whatever, the parallel lines continued to function right straight through, and if you will observe in the bottom chart, the table to the right of the bottom chart, the top line is marked potential from phase 1 to phase 2, and
6893 the voltage there is shown as condition No. 1—68,200 volts, 67,000 volts, and 69,700 volts. So that that shows that the potential was normal between those two phases, and the other circuit was not particularly affected at any time.

Q. Had the disturbance occurred prior to the oscillograph, would you have been aware of the existence of the disturbances? A. Yes, we would have known there had been a disturbance all right, and if the switches had cleared all right we wouldn't have known just how they functioned, and if they had failed to clear we would have had no record as to why. The principal advantage of this chart is to permit
6894 the intelligent knowledge of what has taken place so as to apply it to future occurrences, and to avoid anything that isn't right.

Now in this particular operation here, all the equipment worked correctly, but if it had not done so, we would have learned from this chart.

—2,932—

I should like very briefly to describe one or two other cases without extending them at all, to show what the oscillograph does for us.

 6895

An outstanding example of the value of such an instrument was demonstrated by an outage experienced on the 132 kv. transmission line between Osage and Page Avenue. In this instance the line trip-out occurred simultaneously with the flash over of a generator at the Osage plant, and it was generally believed that the line trip-out was due to incorrect relay setting and as a result of the machine failure. That was our conclusion as a group of engineers analyzing the trouble. When the film from the oscillograph was developed, it showed conclusively that a lightning stroke had 6896
first involved the line conductor, and that the line had relayed properly, and that the attendant surge as a result of the lightning stroke, had caused the machine to flash over. In other words, that there was a lightning stroke, and that the machine flash over was the result and not the cause of the trouble.

Many times an incorrect conclusion like that from a case of trouble will cause the operating group to go out and change the setting of relays, which in themselves were originally correct.

Another case which illustrates that occurred at the Cahokia-Rivermines 132 kv. circuits. "Both circuits relayed simul- 6897
taneously at Cahokia and Rivermines. First reports indicated a flash over of one circuit from lightning which would

—2933—

in this particular case have indicated an incorrect relay operation from the other circuit. It should not have gone out and it did. That was a relatively short time after we had put in this new system connecting Osage, and we were much disturbed about it because we thought we had done a very careful job on those relays.

When the oscillograph record was obtained it showed that in addition to this stroke of lightning which we assumed was the only one, that there had been another lightning stroke within 3/100ths of a second after the first, and on the second circuit at a point 20 miles away.

We sent the patrolman up there and located the trouble.

Now that proved that the relays operated correctly, and that there were two cases of trouble at the same time, only one of which did we know about. The damage at the tower
6899 was located, which proved conclusively that the lightning had struck the other line.

The oscillograph by the way permits knowledge of this ground current and a knowledge of our ground resistances, which we keep, permits us to anticipate the location of the trouble and in many cases the man who works up this chart is able to predict the trouble within three or four spans. We can't guarantee that accuracy, but it has occurred that he has predicted the trouble very closely.

In one case we sent the patrol crew out for the third time

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6900 before they found it, basing our conclusions entirely on the fact that it ought to be there as shown by the chart.

That is an illustration of the efforts that are made to maintain reliable service.

Q. Can you tell us approximately when the oscillographs were installed? A. I think these particular ones have been added gradually for the past four or five years. The first one I think was put in about five years ago.

This Rivermines case was the first we had, I think, and that might have been six years, but it is more likely to be five.

—2,935—

Q. Are you able to give us any other comparisons indicating improvements in service over a period of years? A. Yes, from our records we can provide indications of the nature of improvements in the service. I shall read a couple of figures which I have worked up here, and placed in a table, to illustrate this point.

The average rate of failure of distribution transformers in 1930 was 15 per thousand transformers per year. In 1939, the rate had dropped to 6 transformer failures per one thousand transformers, an improvement of 60 per cent. 6902

In 1930 there were 15 cases of distribution wire down per thousand miles of distribution wire in service, as against 6 cases in 1939, or an improvement of 60 per cent.

I have one or two other statistics that I think are worth mentioning to show the improvement.

In our cables in the voltages of 2,300/4,000, up to and including 6,600 volts, the failures per hundred miles of cable per year in 1930 were 21, and by 1939 that had been reduced to 15, an improvement of 28.6 per cent.

In the operating voltage of the 13,000 range, the failures in 1930 were 18, and are now 16, an 11.1 per cent. improvement. 6903

In the 33 kv. cable failures per 100 miles, per year, in 1930 were 42, as against 9 in 1939, an improvement of 78.5 per cent. That was largely due to improvement in the method of making the cable joints.

—2,936—

Now in interruptions per circuit in the distribution circuits, these are the ones that affect the customers' service more than the others, because these transmission interrup-

6904

tions as a rule are taken care of by alternate circuits, but in some of these interruptions which I now indicate, the customers' service would be affected.

In the low voltage class, 6,600 volts and below, the interruptions per circuit were, for 1934—.3 per circuit per year, which had been reduced to .1 by 1939, an improvement of 66.7 per cent.

In the 13,000 volt class of circuits, the interruptions for 1934 were .65, and by 1939 they were .33—again a 49.3 per
6905 cent. improvement.

In the 33 kv. class, the interruptions were .7 for 1934, and .25 for 1939, an improvement of 64.3 per cent.

To interpret these very briefly, to see what they mean, there were 6 transformer failures per thousand transformers in service in the year 1939. The probability is that we may expect one failure every 166 transformer years. Again, with an average interruption per circuit for 1939 of 0.1, another way of stressing that would be that we will, on the average, have one circuit interrupted every ten years.

The above examples of reductions in equipment failures
6906 and circuit interruptions are typical of the results of con-

—2,937—

tinuous efforts by the operating and engineering personnel to analyze troubles and eliminate or reduce, in so far as possible, the causes of such troubles and thereby improve the service rendered to the customer.

The Examiner: We will recess until 2 o'clock.

(Whereupon, at 12:35 o'clock p. m., a recess was taken until 2 o'clock p. m., of the same day.)

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AFTERNOON SESSION

(The hearing was resumed at 2 o'clock p. m.)

The Examiner: Let the hearing come to order.

Whereupon, STANLEY STOKES resumed the stand and testified further as follows:

Direct Examination by Mr. Hamilton (Continued):

Q. Are you able to give us, Mr. Stokes, any statistics indicating the trend of service calls per customer over a period of years? A. Yes, I have examined the records of the trend of customer service calls, and have noted a consistent reduction in the number of service calls per year. This indicates an improvement in the grade of service rendered. 6908

The total records for the customers for the City of St. Louis, commercial and residential classes, have been examined, and I would like to produce the figures for the year 1917, and at 5-year intervals since then, approximately.

I won't read all the detailed figures, but in the year 1917 the service calls per customer, per year, for that year, were .907; in the year 1922, five years later, they had declined to .329. By 1927, they had become .202. In 1932, they were .191, and by 1940 they had, for the 9 months to date, become .170. That is the annual rate, however. 6909

—2,939—

Q. In the case of 1940? A. Yes. It is at the rate, however, of .170 per year, which is consistent with the other figures.

This represents an average interval between calls for a single customer of—in 1940—5 years and 10.6 months. This

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corresponds to an interval of one year 1.2 months elapsed between calls for 1917, which indicates an improvement in the service.

Q. These are trouble calls you are referring to? A. They are really trouble calls, yes, they are calls where the customer has inquired something about the service itself. I have eliminated miscellaneous calls about other subjects.

Among the features which I think are of interest in connection with good service, should be mentioned the free lamp
6911 renewal privileges. All lamps are not renewed free, but practically all of the sizes that are in regular use, are, in the residential service. That has a beneficial effect from the power company's viewpoint, that the customer keeps the sockets filled up and keeps lamps where they should be.

Q. Do you happen to know whether the Illinois Commerce Commission has established ratings for service as among electric utility companies? A. Yes, in Illinois there is a specific method set out by the Illnois Commerce Commission for rating the quality of service rendered.

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6912 Q. Has Union Electric Company of Illinois been so rated, and if so, how? A. Yes, the Union Electric Company of Illinois has been rated. Pursuant to what is known in Illinois as General Order No. 65, the Commission established an engineering section whose duties are to investigate and determine the grades of service rendered by the various utilities throughout the State.

Service engineers visit the various companies, examine their records which are required by their order to be kept, and the examination includes such items as continu[illegible] of

service, voltage regulation, meter testing, maintenance, and some other less important items.

They have quite a crew of service engineers, who go around to different cities and locations, and set their own meters, make measurements, and examine the records, and as a result of which, by a method which they have worked out, they determine, by weighting these different factors, what grade of service is being rendered, and they give reports each year, or almost every year.

In this case the Union Electric Company of Illinois, in 6914
the Commission's report of "Grades for Electric Service", dated February 1, 1940, compiled from the latest grades assigned prior to January 1, 1940, the Union Electric Company of Illinois was ranked next to the highest in the State

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among 29 Class A companies—those are the large companies. The grade itself was 96.41.

In addition to grading the companies themselves, they also grade the service rendered in the different cities. The highest grade in Illinois for that year for service in a Class
A City—that is the larger cities—went to the City of Alton, 6915
Illinois, served by the Union Electric Company of Illinois, with a grade of 96.86. That rating was just a little higher than Chicago.

In the first five cities in this group, the Union Electric Company of Illinois had two of its towns included, Alton and East St. Louis.

This grading, by an impartial authority, indicates a high standard, the high standard of service being furnished by this company.

We have no similar method of grading established in Missouri.

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Q. Turn now to the operating staff of the Group, Mr. Stokes, and I would like to have you describe briefly the names, capacities and functions of the principal members of that staff, excluding, if you will, the higher executive officers, who will be covered subsequently by a later witness. Will you proceed with that description? A. Starting first with
6917 the secretary of the Union Electric Company of Missouri, his name is Frank J. Meistrell. Mr. Meistrell is 38 years of age, entered the service of the company in 1940, was educated at Princeton University, Brooklyn Law School and Harvard Law School. Besides serving as secretary for Union Electric Company of Missouri, he is also secretary of the following companies: Union Electric Company of Illinois; Iowa Union Electric Company; Mississippi River Power Company; The St. Louis County Gas Company; the Union Electric Land and Development Company; and the Cupples Station Light, Heat and Power Company.

6918 As secretary, he is in charge of the corporate records of the companies and the records of the boards of directors. He records the minutes of the meetings of stockholders and directors, and performs other functions specifically assigned to him. He is aided by Eugene R. Kropp, assistant secretary.

He is assistant secretary of the same group of companies previously mentioned. He is 40 years of age and has been with the company 17 years, 8 of which are in his present position. He is a native of St. Louis, attended Washington

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University. Mr. Kropp had the title of assistant to the secretary from 1923 to 1932, before becoming assistant secretary.

The treasurer of the Union Electric Group, the same group of companies, is Mr. John L. Ganz. As the chief financial officer of the company, Mr. Ganz, who is 57 years of age, has been, for 20 years, in his present position, and for 34 years associated with the company. He studied mechanical and electrical engineering at the University of Missouri. From 1906 to 1909, Mr. Ganz worked in the drafting office; 6920
from 1909 to 1916, he was shop foreman of the motor department; in 1917, machine foreman; from 1917 to 1920, he acted as attorney; and from 1920 to date, as treasurer.

Mr. Ganz performs the treasurer's duties for the group of companies mentioned, and assists, advises and cooperates with the assistant treasurers in St. Louis County, Missouri, East St. Louis, Illinois, and Keokuk, Iowa.

Chiefly, his functions are to execute all documents and certificates requiring the signature of the treasurer, such as Federal income and capital stock tax returns, certificates required by trustees, etc. 6921

His duties are to open and establish the deposit and distribution of funds, and in general carry on all contacts with banks relating to company funds; to sign or countersign voucher checks and various special accounts checks; to supervise or carry on all correspondence with holders of pre-

ferred stock; to carry on all correspondence with customers involved in intentional or unintentional diversion of electric service; to jointly with the secretary maintain a record of the

contents of the company's safe deposit boxes; appoint and supervise individual merchants as branch pay station agents; supervise the stenographic and mail delivery service to all departments in the main building.

In the performance of these functions, he is assisted by the following division heads and supervisors: the assistant treasurer, who also acts as claim agent; the assistant claim agent; cashier; general clerk; and supervisor of special inspectors.

6923 Assisting the treasurer in the handling of personal injury and property damage claims is Mr. George H. Hartwein. He is 51 years of age, and a native of Missouri. Four of his 14 years of service have been in his present position. From 1926 to 1936, Mr. Hartwein acted as attorney, and from 1936 to date has been assistant treasurer of the Union Electric Company of Missouri, and subsidiary companies, as well as the St. Louis County Gas Company.

His functions include the handling of personal injury and property damage claims, the signing and distribution of general employe pay checks, and the handling of garnish-
6924 ment proceedings.

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He also takes care of all employe accident claims relating to employes of the Union Electric Company of Missouri, employed in the city of St. Louis, at Rivermines plant, and at the Osage plant, and also those employes of Union Electric Company of Illinois who work at the Cahokia and Venice plants.

Another one of his duties is the preparation of reports of accidents involving any of the companies' automobiles.

Active in claims work and working with Mr. Hartwein, is Mr. Herbert W. Harbison, Jr. Mr. Harbison is assistant claim agent, 33 years of age, and a St. Louisan. His employment by the company totals 11 years, and his occupancy of his present position—four years. He came with the company in 1929 as intermediate accountant in the accounting department. He served in 1930 as a junior accountant, and from 1930 to 1936, as accountant for the east side properties.

In 1936 he did some work as a valuation accountant
before becoming assistant claim agent in that year. 6926

He cooperates with the assistant treasurer, Mr. Hartwein, in the various matters which I have previously listed as under his direction. In addition, he keeps a record of bonds and bond interest coupons outstanding, and cremated, of the Union Electric Company of Missouri, Mississippi River Power Company and the Keokuk Electric Company, which is a predecessor of the present Iowa Union Electric Company.

He also procures certificates of title and licenses for

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automobiles, and handles the issuance of the executive pay- 6927
roll checks and keeps records in connection therewith.

The general clerk of the treasury department is Mr. Herbert H. Bindbeutel, who is 35 years old, a St. Louisan, has been with the company for 20 years, and has held his present position for 12 years.

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He started with the Union Electric Company as an office boy in 1920, and progressed through the functions of junior clerk and collector, outside messenger, senior assistant book-

keeper, preferred stock bookkeeper, and general clerk, to his present position as supervisor and general clerk.

His principal duties are to obtain signatures on all voucher checks, and certain mail, and to record and report the disbursements thereof for the complete list of companies represented by the Union Electric Group.

He also maintains a dividend list of preferred stockholders. He keeps the common stock register and stock certificate books of the Union Electric Company of Missouri, and
6929 subsidiary companies, and keeps the transfer agents supplied with the necessary information received from shareholders, and prepares and files reports to the Internal Revenue Department on bond ownership, and file State and Federal information on returns for all companies, affiliates and subsidiaries.

The cashier for the company is Michael J. King. We always call him Mike King. He has been with the company ever since anybody can remember. He is now 64 years of age and has worked for the company 46 years, 20 of which have been in his present position.

6930 He was employed by the old Missouri Edison Electric Company at the time of its consolidation. From 1894 to 1908 he held a position in the collection department. During

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the years 1908 to 1920, he was assistant cashier, and has been cashier from then until the present time. I have known Mr. King for about 20 some-odd years.

This group, of which he has charge, receives all remittances and payments made to the company from all divisions of the company to which money comes in. He handles

the banking for East St. Louis and transfers accounts from the Alton banks to the St. Louis depositories; also some deposits are made for the Iowa companies in St. Louis.

Minimum bank balances are maintained in St. Louis County, and outlying divisions, and the East St. Louis and Alton division; and the cashier's division handles the transfer accounts to the St. Louis banks. It also handles all city division expense accounts, some for the outlying divisions, and the electric portion of the St. Louis County Gas Company. 6932

I think I can explain that. From what are called the cashier's working funds account—they have an arrangement in St. Louis County wherein customers who have both gas and electric, can pay their bills to either company, I mean you only have to send one envelope, and the company makes the transfer of cash and sends it back. If the electric company receives both the gas and electric bill, they turn over the gas part to the gas company. It saves the customer making two separate remittances, and two postage payments.

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Special investigations are handled by a separate group 6933
under the direction of Vernon J. Goodwin, who is 52 years old, and has been with the company 27 years, 4 of which have been in his present position. He served in various capacities, as repairman, 1913; trouble man from 1914 to 1915; clerk from 1915 to 1920; meter installer from 1920 to 1925; and as inspector until 1927; adjuster until 1936; and supervisor of special inspectors since that time.

The special investigations group handles current theft cases, and irregular connections resulting in unmetered service. They make estimates of the amount owed to the com-

pany for unmetered service, and carry on negotiations with customers for the collection of such amounts. They also make confidential investigations of frauds which may be perpetrated against the company.

The president of the company has an assistant, Mr. Walter G. Heren. Mr. Heren functions as special assistant to carry out any instructions the president may have, and upon certain occasions he acts as assistant secretary for the Union Electric Company of Missouri, Union Electric Com-
6935 pany of Illinois, and the Mississippi River Power Company. He is 40 years of age and has lived most of his life in Missouri.

The comptroller of the Union Electric Company of Missouri and the St. Louis County Gas Company, is Mr. Alwin H. Schettler.

He is the chief accounting officer of the company, and

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supervises through six department heads, all reporting direct to him, all of the accounting functions and correlated subjects for Union Electric Company of Missouri, and sub-
6936 sidiary companies, and the St. Louis County Gas Company.

His supervision extends over 347 employees in the following six departments:

General Auditor's Department, Fiscal and Statistical Department; Accounting Department; Valuation Department; Budget Department; and Tax Supervisor's Department.

Mr. Schettler is 40 years old, and has lived his entire life in St. Louis. He is a certified public accountant of St. Louis, received his Bachelor of Science degree in Commerce

at Washington University, and his Master's Degree at Northwestern University.

Prior to his employment with the Union Electric Group, he was a member of the staff of Price Waterhouse & Company for more than 15 years.

The general auditor of the electric company, that is, the Union Electric Company of Missouri, and the St. Louis Gas Company, is Mr. William Avery. His functions are to review currently financial and operating reports. He conducts operating cost studies and periodically scans accounting pro- 6938
cedures in an attempt to obtain a more uniform application of those methods.

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Mr. Avery also analyzes various accounts and develops or reviews the bases for allocation of costs or other apportionments for recording in the accounts of the respective companies.

He performs special assignments for the comptroller, which are outside of the scope of ordinary routine of the other accounting departments. Mr. Avery has three assistants, two small groups of auditors totalling 11 employes, 6939
called the Internal Audit Group, and the Stores Audit Group. They report to him. He is 51 years old and is a native of Missouri, having been born in St. Louis. He has been with the company for 36 years, 21 of which have been in his present position as general auditor.

The Internal Audit Group is directed primarily to the verification of all balance sheet and income accounts. The Stores Audit Group performs all stores auditing duties for all companies of the group and the St. Louis County Gas Company.

Those are primarily the reconciliation of stock balances, and a general check-up and examination of stores department records and procedure.

The fiscal and statistical auditor of the Union Electric Company of Missouri, and the St. Louis County Gas Company, is Mr. Eugene J. Shapiro, who is 36 years old, has been in service with the group for 15 years, five of which were in his present position. He is a St. Louisan, received a degree

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6941 of Master of Bachelor in Commerce at Washington University, and was first employed as valuation clerk in 1926.

There are 15 employes reporting to him or engaged in the following activities: preparation of data required by Federal regulatory bodies, including particularly the Securities Exchange Commission, the Federal Power Commission and the Interstate Commerce Commission; the preparation of data required by two State regulatory bodies, the Public Service Commission of Missouri and the Illinois Commerce Commission; the preparation of information required by the New York Stock Exchange; compliance with requirements of State
6942 and Federal regulatory laws, and with the requirements of trust indentures of all companies; also the preparation of data required in connection with any redemption or maturity of outstanding securities, and the preparation of data for a large number of statistical reports and general questionnaires, including reports to stockholders and various other agencies; preparation of various balance sheets and other financial schedules of the Union Electric Group of companies; the preparation of certain data, complete monthly reports to boards of directors of the Union Electric Company of Missouri, and the St. Louis County Gas Company, and a review

of data on income and miscellaneous matters to be included in minutes of the meetings of the boards of directors of the various companies.

The operating auditor of the Union Electric Company of

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Missouri and the St. Louis County Gas Company is Mr. Everett J. Emberson.

He was first employed by the group of companies in 1920, as junior accountant. The functions of the operating auditor include the supervision of the general accounting division, 6944
the St. Louis City billing division, the St. Louis City credit, adjustment and collection division, and the meter reading division.

General accounting Division operates under Mr. William P. Crowley, assistant operating auditor. He is 39 years of age and has been with the company 24 years, three of which are in his present position. He is a St. Louisan by birth, started with the company as an office boy in 1916.

The general accounting division performs accounting work for the following group of companies, which includes 6945
the entire group of Union Electric Company of Missouri and subsidiaries and affiliated companies—I will not list them.

In addition to the above, the accounting division acts in a supervisory capacity for the accounting department of the Mississippi River Power Company and the Iowa Union Electric Company, and in a consulting capacity for the St. Louis County Gas Company.

The work performed by this division is in general that performed by any other accounting division, and I will merely indicate one or two items. It includes the prepara-

tion and inspection of entries, compiling trial balances, main-

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taining general ledgers, subsidiary ledgers and other subsidiary records; the preparation of condensed income accounts and balance sheets, and financial and operating reports.

They assist in the preparation of a large group of other data which includes the various schedules for annual reports to the various commissions. Of course, they prepare the
6947 checks for payment of all invoices, reimbursement of all working funds for the companies of the group, with the exception of the Mississippi River Power Company, Iowa Union Electric Company and the St. Louis County Gas Company.

They also maintain the social security records and make reports on those.

In addition to the regular accounting work for the Union Electric Group, they carry on the general books of the Utility Employes Savings & Loan Association. That is an organization similar to any other savings and loan association, except that it is for the Union Electric Group employes.
6948 It has been very successful over many years.

In the billing division Mr. Frank W. Phelps is in charge.

We have pretty well described the functions of the billing division, and the billing and contract accounts group, and I won't go clear through the operations, but he has complete charge of that group of work. He is 38 years old and has been in the service of the company for 18 years, six of which have been in his present position as chief clerk of the billing

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division.

He is a Missourian, started with the company in 1922 as junior accountant, and served in various accounting positions in St. Louis and East St. Louis, becoming chief clerk in 1934.

The chief clerk of the credit, adjustment and collection division is Oscar J. Vosbrink. Again we have discussed the operations of the credit and collection division rather extensively, shown how it functioned. There are 68 persons reporting to Mr. Vosbrink in this division, including an
adjustment group, a collection and outside adjustment 6950
group, a credit group, a credit and final bill group, a special assignments group, and the last group performs miscellaneous work which is carried on for the chief clerk.

He has occupied his present position for six of the 15 years he has been with the company. He is 38 years of age and a native St. Louisan, and was first employed as utility accountant in 1926. He subsequently filled other accounting positions, until he came to his present position in 1934.

As previously discussed, the billing division is carried on in connection with the collection and credit work, and the
foreman of the meter reading division is George P. Zbaren. 6951
He has about 50 people under his supervision, and is charged with obtaining the reading of all electric meters in the city of St. Louis.

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Some of his employes form the addressograph group, and maintain that part of the work as well as the meter reading.

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He is 52 years old, has been in the employ of the company as meter reader foreman for 23 years.

The valuation auditor is Mr. Harold W. Ross. He has served in this capacity for 5 of the 6 years he has been with the company. He is 51 years of age, a native of Illinois, and presently resides in St. Louis.

Prior to his employment by the Group of companies, he had been chief accountant of the Missouri Public Service Commission for 7 years, and had 17 years valuation and regulatory experience with that Commission, and the Interstate Commerce Commission.

6953 The valuation department, consisting of 30 employees, is directly under his supervision, and includes three groups whose principal functions relate to work orders. Different companies have different names for those, but those are the orders which approve the expenditure for property and plant. He also has under his supervision property accounts, appraisals and valuations—those are the groups.

This department makes contact with State and Federal regulatory authorities in matters pertaining to property accounts, appraisals and valuations. They perform the functions for the Union Electric Group as a whole.

6954 The work order group controls and audits work order expenditures, checks work estimates, and the proper accounting therefor, and maintains a current record of these work

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orders. The work order is the source of authority for all expenditures for property and plant. In other words, if I want to put in a sub-station, estimates are drawn up and completed and put on what we call the work order form, and that is submitted to the management for approval. It then goes to the valuation department for various checking, and becomes the authority for the expenditure.

That work order group prepares monthly journal vouchers to record the provisions for current depreciation for all companies except the Mississippi River Power Company, Iowa Union Electric Company, Union Colliery Company, and St. Louis County Gas Company.

In the property accounts group is developed and maintained the continuing property records for all companies except Mississippi River Power Company, Iowa Union Electric Company, Union Colliery Company, St. Louis & Belle-
ville Electric Railway Company, and St. Louis & Alton Rail- 6956
way Company. These companies at present do not have continuing detailed property records.

This group analyzes and verifies the accounting for all plant expenditures and retirements, and makes the necessary analyses for proper capitalization of general construction overhead.

Plant expenditures and retirements are summarized by established property units and are currently recorded in a

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continuing property record, which is kept in balance by sum-
marization into the plant accounts, prescribed by regulatory 6957
authorities. You understand what I mean by continuing property records? That is, they keep a record of every item that is added to the property and plant, in detail, both as to the physical property and valuation, and remove and keep a record of removals of all the property withdrawn.

Among other things, this group develops and maintains physical property statistics which are used as the basis for reports to regulatory authorities, and for many other purposes. It also makes depreciation studies and assists in making appraisals.

The property accounts group has been engaged in the determination of original cost of physical property as required by Federal and State authorities, and in the reclassification thereof into prescribed accounts. All schedules and data required by regulatory authorities have been prepared and filed, and the necessary entries to record the various classifications are in the process of preparation.

The appraisals and valuations group makes all appraisals of property. At the present time this group is engaged in
6959 an appraisal of the property of the St. Louis County Gas Company, in accordance with an order of the Missouri Public Service Commission.

The next division to be discussed is the budget depart-

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ment, of which the head is the budget auditor, Mr. Arthur P. Lucchesi. I have known him for many years or I wouldn't be able to pronounce that word.

He is 44 years old and has been with the company for 27 years, 5 of which have been in his present position as budget auditor.

6960 He has had various positions. He was employed in the billings department in 1913, and has held many positions in the accounting department and in the billing division before becoming assistant general auditor in 1922, and budget auditor in 1936.

The functions of the Budget Department, which includes 7 other employees, consists of the preparation of operating estimates, summarization of and the maintaining of control records for construction and retirement budget; summarization, coordination and the maintaining of control records

for the operating and payroll budget; and the preparation of cash budget requirements, as well as other cash estimates.

The tax supervisor's department is headed by Mr. Walter S. Alt, with a title of tax supervisor. His work is for the Union Electric Company of Missouri and subsidiaries, and the St. Louis County Gas Company.

He is 49 years of age, and an attorney, and for the last 18 years prior to his employment in this Group, had been connected with the Bureau of Internal Revenue, the last 6

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years as a member of the Bureau's technical staff.

His department consists of 8 employees, and he is charged with the duty of preparing all Federal, State and local tax returns, with the exception of real estate and personal property tax, city of St. Louis merchants' and manufacturers' license tax, Missouri, Illinois and Iowa annual reports, and Missouri franchise tax returns.

As an example of the types of returns which are required —I won't attempt to list them all—but they are all under his supervision. We have, under "Federal": income tax, capital stock tax, electrical energy tax, admissions tax—— 6963

Q. (Interposing) I don't think you need to go through that. A. All right, that is just a percentage of them.

That department has some other routine duties in addition to their tax return work, all having to do with tax records in one form or another.

The next gentleman under discussion is myself. I have already qualified, and I don't know as any further discussion of my position is necessary.

My department is a small group of highly technical engineers with Mr. Harold Gove as my assistant. He is 35

years of age and has been in the employ of the company for 11 years. He is a native Missourian and graduated from Missouri University in 1929, with the degree of Bachelor of Science in Electrical Engineering.

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Subsequently, he obtained his Master's Degree in mathematics from Washington University in 1935. We permitted Mr. Gove to do some outside study in connection with his regular work because he was very proficient in mathematics,
6965 and we needed an engineer-mathematician. We found that a straight mathematician lacks too much knowledge about the practical application of the work, and altogether Mr. Gove has been sent to school off and on for approximately 8 years to study special mathematical application. It has been very helpful in our work.

He now makes all the transmission line calculations, stability studies, and things of that kind, as well as functioning as a general assistant.

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The director of industrial relations is Mr. W. D. Alder-
6966 son. The industrial relations department is responsible for employe relations activities, and we have in the group of companies an organization known as the Employes Mutual Benefit Association, which represents the employes in all of their dealings with the company, and as a part of that association activity, they have many types of benefits, such as doctors' services, dental services, employes' recreation clubs, and other related matters.

Mr. Alderson has charge of those activities. He is 59 years of age, has been in the employ of the company for 30

years, and in charge of the present type of work for 21 years.
He is a native Missourian, has lived in St. Louis and St. Louis
County all his life.

He has 23 permanent employes under his direction. In
the summer months we operate an employes' club, and there
are 23 more employes out there that report to Mr. Alderson
when the club is in operation. His assistant, Mr. M. B.
Mathis, is 39 years of age, has been in the employ of the
company since 1922. He was first employed as secretarial
clerk in the secretary's office, and has been assistant to Mr. 6968
Alderson for the past 17 years.

The employment division comes under the industrial relations department and takes applications for employment,
interviews applicants and selects new employes. All requests

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for employes on the part of the company divisions come
through this department. They maintain all employe records for the system, supervise the application of the wage
schedule and salary adjustments for employes which are on
what we call scheduled rates.

They report authorized payroll information to the various 6969
departments, and to the payroll division of the accounting
department.

The medical division—of the industrial relations department is maintained at all times and embraces a medical office
and district physician's services. A regular practicing physician is on duty in the medical office, one doctor in the morning an one in the afternoon, for examining new employees
and for handling emergency cases in or near the building.

A nurse is on duty throughout the day. There are 24
regular practicing physicians in various districts throughout

the St. Louis area, who provide ordinary medical service for employes and their immediate dependents. There are also four specialists on eye, ear, nose and throat disorders.

The industrial relations department maintains a service of this kind and sees to it that the employes get this service at reduced rates, or in many cases at no charge.

A similar type of operation applies to the dental division which also has offices in the main building, and includes one

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6971 dentist available all day, and an additional dentist in the afternoon. And the dentists have an assistant at all times.

Mr. Alderson supervises the safety program wherever contracts with the Employes' Mutual Benefit Association are in effect, except in the Keokuk district. This work is carried on through a central safety committee made up of employes from the various districts. There is also a safety coordinating committee which serves as a medium of obtaining action in the correction of hazards.

Most of the recreational activities throughout the company are cleared through Mr. Alderson's department.

6972 The general superintendent of electrical operations is Mr. George K. Miltenberger. He is directly responsible for operation of electrical power producing and transmitting facilities of the Union Electric Group. The following departments are under his supervision: Construction Department; Electrical Distribution; Electric Power Plants; Hydraulic Engineering—the Hydraulic Engineering Department is actually engaged in direct operating work, the name is somewhat misleading, but it carries on engineering work in hydraulic matters and operating work as well.

The Osage Power Plant operating group reports to Mr. Miltenberger, the steam heating, stores and transmission department also.

He is 51 years of age, and has had 25 years of service

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with the company, 10 in his present position. He is a graduate mechanical engineer of Cornell University, and began work as power salesman in 1916. He is a native of St. Louis.

As assistant to Mr. Miltenberger is Mr. George P. Gamble. Mr Gamble is 41 years of age, has been with the company 6974
9 years, 5 of which has been in his present position.

Prior to his connection with the company, he was employed by Stone & Webster Engineering Corporation for a number of years on both construction and engineering work. He received his engineering degree from the University of Virginia, is a native of Richmond, Virginia. He acts as direct assistant to Mr. Miltenberger on any assignments.

A small construction group reports to the general superintendent of electrical operations—that is Mr. Miltenberger. The chief of this small group of construction people is Mr. Edward A. Rudulph, who is 45 years old, and had 9 years 6975
of service, in his present position. He is a native of Bowling Green, Ohio, and graduated with a degree in Civil Engineering from Rensselaer Polytechnic Institute.

Previously he was associated for a number of years with the Stone & Webster Engineering Corporation. He came with the Union Electric Group as assistant engineer in 1932, and now has the title of design engineer, and has had it since 1936.

The superintendent of electrical distribution is Mr. Chris

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H. Kraft. His department, which consists of 365 employes, is engaged in the engineering, construction and operation of electrical distribution system. This does not include the operation of the sub-stations themselves, which are under the power plant and sub-station division, which report to the preceding gentleman, Mr. Miitenberger.

We have already described the distribution department in some detail, and since it represents about 25 per cent. of the investment in the company's properties, its is obviously an
6977 extensive part of the system.

Mr. Kraft is 49 years old, a native of Missouri, has been with the company for 25 years, 15 in his present position.

I was instrumental in getting Mr. Kraft his job with the company. He was first employed as assistant in the general manager's office in the St. Louis County Division. He then worked as an operating engineer and as a superintendent of distribution. In 1920 he became distribution engineer with the St. Louis City Division, and then electrical engineer, and then assistant superintendent of electrical distribution, and finally his present position as superintendent of electrical dis-
6978 tribution for the City Division. He is a graduate of Missouri University.

The chief clerk in the distribution department under Mr. Kraft is Mr. Fred W. Blanche. The clerical division of the distribution department keeps the records and does all of

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the office work for the entire department, maintains a daily record of the activities of the various construction crews, prepares estimates of the cost of construction and maintenance

work, has charge of the customer card records, and many other operations, some of which have been described.

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The supervision of the company's branch telephone exchanges is under Mr. Blanche's direction. He is 46 years of age, a native of St. Louis, has been with the company for 29 years, 14 of which have been in the position he now holds.

He went through the various jobs of drafting clerk, draftsman, chief record draftsman, engineering clerk, junior distribution engineer, and assistant distribution engineer, 6980 and then his present work.

You see, in a department of that kind, records are not only matters of typewritten form, but they also include a large group of charts and maps, load density maps, and records of pole lines on streets, and the record work there is a combination of map work as well as ordinary bookkeeping.

The operating superintendent in this division is Mr. Rollo C. Morris. You see the distribution division is divided into two basic parts, the construction and the operation. Morris is in charge of the operating part.

Under him are three major groups which may be described 6981 as operating engineering, emergency trouble dispatching, and emergency field force.

There are some minor groups representing appliance repairs and other features under him. Mr. Morris is 40 years of age, a native Missourian and has been with the company 20 years, 15 years of which have been in his present position.

I have very frequent contacts with Mr. Morris in connection with developmental work in the distribution depart-

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ment, and find him very able. His first position was that of junior electrical engineer, since which he has had various positions as junior assistant distribution engineer, senior assistant distribution engineer, assistant distribution engineer, and his present position. He graduated from the Missouri University, with the degree of Bachelor of Science in Electrical Engineering.

I happened to be an assistant in physics there one year, and Mr. Morris was one of my students in physics laboratory
6983 work.

The chief draftsman in charge of the records division is Edward H. Geers. He has two groups of employees, one the permit group, that have all things to do with city permits for construction work, correspondence with other companies relative to exchange of pole space, pole records, right-of-way easements, agreements, and so forth; and a drafting group, which handles and maintains the plat record of the overhead and underground systems.

He is 46 years of age, and has been with the company
6984 for 25 years, 15 of which have been in his present position.

He is a native St. Louisan, first employed as filing clerk, and then as plant draftsman, record draftsman, chief record draftsman, and now in his present position in charge of the records division.

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The engineering subdivision of the distribution department is under the direction of Mr. Roland A. Lea. This group is responsible for the preparation of detailed plans and estimates of construction, reconstruction, extension and maintenance of distribution systems.

Mr. Lea is 51 years of age, a native of Kansas, and has been with the company for 28 years, fourteen of which have been in his present position.

He has held various positions as station meter tester, engineering clerk, assistant distribution engineer, and distribution engineer.

He graduated from the University of Arkansas with the degree of Bachelor of Science in Electrical Engineering.

The installation division is operated under the direction of Mr. John E. Weis. They have general charge of the meter 6986
installations, removals and miscellaneous installation work.

Mr. Weis is 61 years old, a native of St. Louis, has been with the company for 36 years, 21 in his present position.

His first job was meter man, and then as special estimator and installer.

In the operation of the distribution department, it is divided into two geographical divisions, with Mr. George C. McLaughlin in charge of the north district. He is 60

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years of age, a native St. Louisan, and has been with the
company for 44 years, 8 of which have been in his present 6987
position. He was first employed as a ground man and worked through various positions up to his present position of superintendent in charge of the north district.

In similar work, Mr. Fred A. Silvers is superintendent of the south district. He is 53 years of age, a native Missourian, has been in the company's employ 25 years, of which 14 have been in his present position. He has also had a number of jobs, always in the same kind of work.

The underground conduit division is in charge of Mr. James L. Coughlin. He supervises three crews of 14 men

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each, whose work includes excavation and installation of underground conduits, transformer vaults, manholes, and service laterals.

They also cooperate with the steam-heating department and install steam mains and steam service laterals.

He is 50 years of age, a native of St. Louis, has lived in St. Louis all his life. He has been with the company for 37 years, 5 of which are in his present position.

He had a number of other positions starting in as cable
6989 man, and working through foreman and other jobs until he got his present position as superintendent of the conduit division.

The superintendent of the cable division is Mr. William

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H. Burggraf. Similar to the underground conduit division, they install cables throughout the city, including the submarine cables to Cahokia and Venice plants in Illinois. They also install all the service laterals to customers' premises, and make cable repairs and handle cable failures.

He is 58 years of age, a native St. Louisan, and has been
6990 with the company 34 years, 4 years in his present position.

He was first employed as a cable man, and then became a splicer's helper, then crew foreman and assistant underground superintendent, before obtaining his present position.

The superintendent of electric power plants is Mr. Charles C. Robinson. He is 60 years of age and has been with the company for 29 years. His first employment was with the Mississippi River Power Distributing Company, a predecessor company, on construction work. As a matter of fact, it

had to do with the construction of the Page Avenue sub-station.

He has had various positions, as superintendent of sub-stations, superintendent of power and transmission department, superintendent and load dispatcher, assistant electrical engineer, superintendent of electric power plants,—which position he now holds.

He graduated from the University of Missouri and has a degree of bachelor of science in electrical engineering.

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He is responsible for the electrical operation in all the power plants, and the major transmission sub-stations, and the chief load dispatcher reports to him.

The testing and calibration of watt-hour meters in the St. Louis City Division is under the meter department, the head of which reports to Mr. Robinson. There are 334 employes in his division.

The superintendent of sub-stations, who is Mr. Robinson's direct assistant, is Mr. Oscar J. Rotty. Mr. Rotty is 42 years of age, a graduate of Missouri University, with the
6993 degree of Bachelor of Science in Electrical Engineering, and entered the service of the company 19 years ago. He has had quite a succession of positions, starting in with graduate engineer, and is now superintendent of sub-stations. "Graduate engineer" there means that he just graduated from college; it doesn't mean that that is the top job.

Mr. Rotty has charge of the operation and maintenance of all the distribution sub-stations within the city limits of the city of St. Louis, as well as the Page Avenue station, which is located just outside the city limits in St. Louis

County. He acts as assistant superintendent in the absence of Mr. Robinson. He also does some construction work.

The supeerintendent of the major power plant at Cahokia, whose job is known as electrical superintendent, is Mr. Harry O. Duetscher. He is 42 years of age, employed for 23 years, and is a native of St. Charles, Missouri. He has had

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most all the jobs in the electrical installation work, starting with wireman's helper in 1917, thence wireman, foreman, sub-
6995 station division electrical superintendent—which he now holds.

He is responsible for the operation and maintenance of all electrical equipment at the Cahokia and Venice power plants, with 84 men under his supervision.

The meter department, which I just mentioned, is under the direction of William L. Hunker. They handle the meters for the City Division. He is 57 years of age, has been employed by the company 32 years, 25 of which have been in his present position. He was meter tester to begin with. He graduated from Missouri University. He has charge
6996 of testing and adjustment of all customers' meters, and a major portion of the meters used for recording and controlling system operations. He also has charge of the laboratory where standards and other instruments are calibrated.

He also does testing of various kinds, all the way from safety devices up to testing an electric range.

The chief load dispatcher is Mr. Oliver L. Luft. He was born in St. Louis 46 years ago, and has served the company 26 years, beginning as an oiler, and then an operator in sub stations, and then an operator at Cahokia, then a fore-

man, general foreman, and since 1935, from 1935 to date, he has been chief load dispatcher. Mr. Luft, and the load dispatchers whom he supervises, collect the data used in fore-

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casting load conditions, coordinate electric generation of steam and hydro plants in the whole system, and are responsible for switching operations on the transmission lines delivering energy to the sub-stations.

The electrical superintendent in charge of the Ashley Street power plant is Edward S. Murdock. The old gentle- 6998
man is 77 years of age, has been with the company for 47 years. Part of this time he was with the Missouri Edison Company, prior to its consolidation. Mr. Murdock is a very interesting man and you would never suspect that he was anything like that age, and he is such a thorough operator that the service which he is able to provide from the Ashley Street station is comparable with the service which is obtained from some of the newer plants, approximately. He is the most remarkable man. He won't be with us much longer because he is about to be retired on a pension basis, but the company will miss him. 6999

The Examiner: We will take a short recess.

(Whereupon, a short recess was taken.)

The Examiner: Let us resume.

A. (continued): The chief hydraulic engineer for the Union Electric Group is Mr. Albion Davis. He is responsible for the efficient use of hydro generation on the system which I have described at some length heretofore. He is 49 years of

age and went to work first as an engineer at the Keokuk plant in 1914, when it was being constructed.

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He is a college graduate.

Three engineers report to Mr. Davis in the St. Louis office, and two engineers, one at each hydro plant, work in conjunction with him in handling the hydraulic operating schedules. His department also cooperates with the governmental agencies in the collection of current hydrologic data, main-
7001 tains rainfall and river gauging stations, prepares forecasts of river flow and power available, which are sent to the load dispatching office.

Daily, weekly and monthly the forecasts of hydro power are prepared in advance for the benefit of the steam plant operations and the scheduling of load.

The hydraulic department is pretty much of a self-contained division in our company, and where there is any special type of maintenance such as examination of turbine runner for pitting or any repair work of major proportions, Mr. Davis is always called in, in connection with that work.

7002 The superintendent of the Osage plant is Mr. Turner White, Jr. Mr. White is 46 years of age, has been with the company for 10 years, 9 in his present position. He has 40 employes reporting to him in the operation of the Osage station.

The steam heating department is under the supervision of Mr. J. E. Hillemeyer. He also operates the little Cupples station of the light, heat and power company group, because

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it is essentially a steam operation. He has 38 employes reporting to him.

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He is 59 years of age, and has been 30 years with the company, 14 of which have been in his present position as manager of the steam heating department.

His first position was in the St Louis County division as engineer, in 1910.

The general storekeeper for the company is Mr. Robert S. King. He is in charge of the main storeroom, and all of 7004 the sub-storerooms, and that includes the delivery of material and operating a fleet of trucks, and he also is in charge of the utility shop.

The name "general storekeeper" is a little misleading for Mr. King, although that is exactly what he does. Still, the position is more responsible than the name would indicate, and he has one of the major jobs with the company.

He has 109 stores employees reporting to him, and 71 shop employees. He is 46 years old and has been with the company for 29 years, 21 in his present position. He started as a clerk in the sales department. 7005

He has 5 assistant general storekeepers, as well as a superintendent of the shop, under his supervision.

Mr. Tillman, Francis A. Tillman, has general charge of the shop, and that includes under that the salvage operations where they recover the wire and material from the cable and salvage as much of the material as possible.

Mr. George W. Couch is superintendent of transmission.

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He has charge of the operation of the major transmission

lines in the St. Louis district, including the main Osage circuits and other high voltage lines.

He has 22 permanent employees. He also has charge of the operation of the Rivermines sub-station and the electrical operation of the Rivermines power plant.

In the summer months, of course, he increases his force materially and does extra work, and frequently runs his group up by 55 or 60 men during such period. His first job was that of a sub-station helper in 1913. He is 47 years of
7007 age and has been with the company 27 years.

Mr. Couch was reporting directly to me for a number of years as superintendent of the Franklin County division, in which he at that time had certain responsibilities, quite different from his present work. But he has been very successful in everything he has attempted.

The rate department is under the direction of Leslie V. Nelson. Their job is to study and analyze rates and correlate the rates with the cost of service, and analyze the various classes of rates.

Surveys are conducted with the purpose of standardizing
7008 all contracts for supplying electric energy in similar classes of service.

He has 6 employees in the rate division. Mr. Nelson is 45 years of age, has been in the employ of the company

—2,981—

for 15 years. His first position was as power supervision engineer in 1926, at which he reported to me.

The real estate and tax officer for the system is Mr. Harry C. Williamson. He represents the real estate and tax matters for Union Electric Company of Missouri and subsidiary companies, and St. Louis County Gas Company.

He is 39 years of age, and began his service with the Union Electric Group as a tax clerk in the real estate and tax department in 1931. He became assistant real estate and tax officer in 1934, and his present position is that of real estate and tax officer for the group.

He has charge of the administration of all real estate and personal property, corporate, franchise and other forms of taxes, including the local improvement and license taxes. He files the tax returns and checks the payments on approxi-
mately 4,400 tax bills on property located in many separate 7010
political subdivisions.

He also has charge of the superintendents of the non-operating properties, such as the 12-story Insurance Exchange Building which is adjacent to our office building.

He has a personnel of 16 employees looking after that type of work.

He has 9 employees in his own department directly engaged on tax matters, and real estate matters.

One of his men obtains the right-of-way for the trans-

—2,982— 7011

mission lines, and that sort of work.

The research engineer for the company in the research department is Mr. R. Banks McDonald. He is 36 years of age and has been with the company 13 years, and has had his present position for 2 years.

He graduated from Washington University in St. Louis, attended the Harvard School of Business Administration for a year. His first position with the company was tabulator in 1928.

There are 11 employees in the research division under his direct supervision, and they make special studies on particular assignments, mostly of a business or economic nature, and conduct some general studies of a more or less routine nature.

In addition, Mr. McDonald acts as representative for the management, from time to time, in a discussion of labor matters with representatives of the Employees Mutual Benefit Association. He sits as one of the two representatives
7013 representing management on the Board of Adjustment, which is composed of these two representatives, and three representatives representing the employees, which is the Employees Mutual Benefit Association.

In other words, the Association has three representatives and the company has two, and they have a board of adjustment which hears matters with regard to wage changes and complaints.

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If an employee feels that he is not either properly treated with respect to his working hours, or conditions, he reports
7014 it to this group, and they have a conference and decide the question.

Mr. Charles E. Michel is the vice president in charge of sales, and is acting as the general sales manager, and has complete charge of all sales activity. There are 215 employees engaged in that work, including industrial power sales in St. Louis County, and the outlying Missouri territory.

Mr. Michel acts in a consulting capacity to coordinate the sales activities of the entire system, although the direct

sales work in St. Louis County is not under his supervision, but he sends special engineers into the County for particular work on request.

He is 65 years old, and has been with the company for 34 years, 5 of which have been in his present position.

He has lived in St. Louis all his life. He entered the service of the company in 1907 as manager of the automobile department. At that time they were beginning to try to push the electric automobile, and it was kind of an uphill job, it didn't work out so very well. But he was very active 7016
in the work.

He then became the manager of the appliance department, which he carried on and gradually developed up through the various sales positions to his present position.

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He acted temporarily in a sales capacity for the Milwaukee Company for a while during the period from 1918 to 1923.

The sales manager reporting to Mr. Michel is Warren L. Berry. Mr. Berry is directly responsible for and supervises the following divisions of the sales department, each 7017
of which is an independent group and has a number of employees: Industrial Sales; Commercial Sales; Residential Sales; Merchandising; Outside Appliance Work; Rural Service; Industrial and Commercial Lighting; Industrial Heating; Commercial Cooking; Air-Conditioning; Isolated Plants —and by that I mean the division of the sales group who are assigned to try to sell electric service to any plants that are still in operation independently.

Continuing:—Rate and Statistical Work. That is a joint activity: The rate department makes the general rate

and inspectors; a number of draftsmen; 77 clerical employees; 165 foremen, along with all the other classes of linemen, splicers, trouble men, wire men, meter men, meter testers, and other skilled employees—the group totalling up to 894.

Q. Do you have equipment specially suited for work on the distribution system? A. We do. In the previous testimony I have described our general transportation system as to number of trucks and so on, and here I will briefly mention two or three pieces of equipment of particular interest.

In order to lower the network transformers into their vaults, we designed and constructed a 10-ton truck crane which can be swung around with a boom sufficiently long to extend out over the sidewalk and yet be able to handle a large network transformer unit.

The customary types of road-breaking equipment, air compressors, drills and so forth, are in continuous use and we have a number of the mobile type air compressors which not only are economical, but do the work with more rapidity and do a better job.

Tractors with power winches are used for pulling cable and similar items.

Trenching machines are available from one of our groups, which can be obtained on a moment's notice.

The other transportation equipment is passenger cars

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and ordinary trucks which I have mentioned heretofore.

During unusual emergencies we have been able, in one or two instances, particularly the tornado which has been described, to obtain additional equipment on very short notice. Several contracting firms worked very closely with the vari-

ous companies in our group, and they have a large amount of equipment which is readily available.

Q. Can you give us some statistics to show the extent of the distribution system as so operated? A. Yes, I have previously described the sub-transmission system and I did mention some miles of single wire. At this time, I should like to point out that there are over 10,000 circuit miles of overhead distribution circuits of all voltages in operation on 147,116 poles, plus joint service on over 100,000 poles of other pole using companies. By that I mean where we are joint 6614
with them, they likewise have other poles where they have circuits on ours. Primarily, of course, that is the telephone companies.

These data, or these circuit miles, are in addition to the underground cable and other facilities previously described, although in this 10,000 circuit miles would be included some of that wire which was mentioned only as a single item heretofore.

Over 24,000 transformers of all types, with a combined total capacity of 462,500 k. v. a., are in use.

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Many of our major industrial customers own their own transformers, and others occasionally buy power from us, metered on the high voltage side of the transformers at what is usually referred to as primary voltage.

Q. Do your maintenance and operating practices take weather conditions into account? A. They have to pay very close attention to weather conditions and be guided accordingly. The lightning and particularly sleet, wind, rain and temperature, are all factors which have to be considered in

the organization and in the equipment. None of these approach calamity proportions except on rare occasions, and those I believe have been sufficiently covered in other discussions.

Q. In times of calamity do you concentrate your forces as a group? A. We do. I mentioned previously that in the case of a large sleet storm that we had stopped a construction job and transferred over 150 men from one point alone, and I believe that although this distribution system is separate
6617 and distinct from the other one, the sleet storm has a similar effect, and I think we covered it rather extensively and I will simply say that the same situation which existed with respect to our sub-transmission overhead circuits, also applies to many of our distribution circuits, and in the sleet storm of 1924, we had a very serious situation to cope with. It occurred just about a week before Christmas due to a little

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warm weather that stayed for several days right around the freezing point, and it begun to drizzle. This word "sleet" is not technically correct for what we are talking about.
6618 The correct term is glaze. The sleet never reaches any proportions to bother with, but when it rains a week with a steady drizzle, and the temperature is about 1 degree below freezing, and then the ice forms on the wires and we have icicles from 18 to 24 inches long hanging every 4 inches on a wire, when you weigh that up, the weight is a good deal per foot of wire.

In cases where the poles were so strongly guyed up that they couldn't break off at the base, some of them would break off 6 or 8 feet from the top.

But under those conditions it is surprising how quickly service is resumed, and the general information that we have received from our customers and their comments are nearly always commendatory with respect to the efforts that we make, and the ability to restore service as quickly as we did.

When we realize that those things only occur on the average once every 18 or 20 years, it is impossible to do better than attempt to repair them quickly.

Q. Do you have the problem of tree trimming? A. Tree trimming is in my opinion, when properly regarded, more 6620
of a social problem than a technical one.

One of the best ways to create good will in any district is to be sure that your tree trimming crews are highly pro-

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ficient foresters and if you haven't any men of your own like that, you had better hire the work done. We do both. In some of our divisions we hire the professional foresters on a contract basis, to do our tree trimming. In other divisions we have hired men who have—who are foresters, and have been engaged in that work and have developed our own forestry crews. In either event, we do regular tree trimming 6621
and in the residential and populated areas we use the greatest care in trimming the trees, as they should be trimmed, and not just to suit our wires.

While the men are on the job I don't mind mentioning that if a customer, whose trees are being trimmed in the rear or front of his house, has another tree or so that needs a little touching up, we reciprocate, we trim that tree for him. We have to go into his yard and trim his tree to clear our service wires, and if we can trim another one for him at the same time, we are glad to do it occasionally. It pays its way in

good will. That isn't the viewpoint that was always used in these companies. I have seen trees trimmed otherwise many years ago. But I believe it is essential to get premission from these people to trim their trees. You do, in many cases, have a perfect right to go in and trim them, but it isn't always diplomatic to exercise your rights in that way, and that is one point in which our company has gone to great length, and we have had meetings on it, and we have had comparisons with some of our sister companies and I believe it is

6623 —2,824—

the general viewpoint throughout the group now that you have got to recognize other people's rights and act accordingly, and if you are going to trim trees, do it like a gentleman.

Q. Have you any statistics to show the extent of the construction, maintenance and operating activities of the distribution and distribution sub-station department? A. I do, I have some figures to illustrate in general the magnitude of the work. I do not know just what other use can be made of them, but they illustrate about the size of the system.

6624 The 1939 distribution construction expenditures were as follows: St. Louis City—$1,907,000, (I am reading the nearest round figure); St. Louis County and outlying districts—$1,185,000; Illinois—$489,000; Iowa—$133,000.

I mentioned heretofore that we are in the early stages of some distribution and construction changes in the one city of Ft. Madison, which will cost us nearly $400,000, but that figure will show next year.

The operating and maintenance expense for the city division was $906,000; the St. Louis County and outlying districts—$490,000; Illinois—$294,000, and Iowa—$75,000.

The total distribution investment as of January 1, 1940, which is intended to be given here only approximately, but which is actually taken from our books as the property and

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plant record, is $34,390,000 for the city; $14,895,000 for the St. Louis County and outlying plants; and $6,195,000 for Illinois; and $1,318,000 for Iowa. That is for the 12 months' period ending December 31, 1939. It includes the distribution sub-stations which, in the city and St. Louis County are under the jurisdiction of the electrical power plants depart- 6626
ment. That is, I have grouped in those figures the distribution poles, wire and distribution sub-stations.

Q. Do you have any regulations or installations on customers' premises to provide for service? A. Yes, we have provisions which are known as service entrance regulations, and which provide a guide to the customers and to the wiring contractors, so that the service entrance facilities are of uniformly high standard, simple in construction, and adequately protected.

By "service entrance" I mean the method and the location
and the materials which are to be used in bringing the service 6627
into the customer's building, and the cost of which is to a large extent borne by the customer.

We bring our wires up to the building and down to the meter, if it is one of the new sequence installations which are usually out of doors or in the old type installation our wires go into the service switch, which is inside the building wall, and from there on the customer has charge and owns the equipment.

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The so-called new sequence metering is now standard throughout the system, and I don't mean to say by that that I believe that every meter on the system is connected that way. I do not think they are, and the facts are that as fast as our meter men get around, we are changing the older installations, but the majority of them have been already cut over.

This sequence metering is of no particular instance, it is simply a revision of the older method by which they used
6629 to put the entrance switch ahead of the meter and then a meter, and then a bunch of fuse wires. Today, in the modern installation, the meter is usually placed out of doors in a case, and by "case" I mean the weatherproof protection that goes over and surrounds the meter. That type of meter is designed to plug in with a bayonet type of fitting and it can be removed quickly. The whole equipment is made weatherproof, and it also has advantages because it is practically theftproof.

So that that is the present standard of meter installation. It has many advantages, it eliminates the annoyance
6630 from meter readers going into the residence and saves us the trouble of making re-reads when the customer is not at home.

If we have to locate the meters in indoors, we are paying particular attention to accessibility and the place where we locate them.

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Our larger light and power customers are served in whatever manner suits them, and their requirements. Some of them own their own installations, and in many of those cases they have made contracts with us to maintain and operate their sub-stations for them, that is treat the oil, see

that everything is in condition, and that it is kept in the
best possible shape.

We make a charge for that service, although we make
a certain type of inspection service for these customers
without charge. Many of those installations for the smaller
power customers have been designed and constructed with-
out any charge to the customer. It is simply a matter of
good business to aid the customer in using our service and
in selecting it, and what is quite a major undertaking for
him,—he gets some kind of an engineer to design and lay 6632
out these things—it is a very simple and inexpensive thing
for us to do, and we have helped the customer out on many
of those installations.

Primary metering, which is metering on the high voltage
side of a customer's transformer, is used whenever the cus-
tomer wants to have several classes of service. That is,
he may want commercial lighting or some other kind of
lighting, and power service, all off of one transformer bank.
For simplification then, we simply put the meter on the high
voltage side, and he does what he likes with the energy,
and it permits us to have one contract for the one installa- 6633
tion.

In the City of St. Louis, customers are supplied from

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either the direct current system or the downtown A. C. net-
work, in which the service facilities furnished include a
junction box at a point where the underground service
enters the building.

As previously stated,—and I believe made quite clear—
the additional service in all the newer business is being
taken on the low voltage A. C. network.

Q. What do the office divisions of the distribution department do? A. Well, I went into that a little bit in previous testimony here, in which I pointed out that one of the necessary features of successful operation is to constantly study your system load growth trends and other features.

The distribution engineers, estimators and inspectors have to constantly keep in touch with the growing load and be sure that their facilities are kept up, and in such capacity
6635 to suit the load. Furthermore, they have to plan extensions into new subdivisions, and see that the new customers and the additional load requirements of existing customers, are properly taken care of.

In addition to that, the system expansion to provide for the additional load, ranges sometimes from merely a reinforcement of minor sections of a line, to a major undertaking which requires the construction of a new sub-station. Without going into a lot of detail about the various sizes, a sub-station such as I have in mind will run from a minimum

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of $150,000 up to about $300,000, and usually starts out with two—12,000 k. v. a. transformers.

I mentioned previously the cooperation between ourselves and the city with respect to civic improvements, and the clearing of streets, and that was mentioned with respect to our subtransmission system, but it applies equally to our distribution system. I pointed out how many miles of circuit we cleared in the street each year, and I won't repeat that.

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There is one feature that is of importance in the minimizing of total expense, and that is to see that the Bell Telephone requirements and ours are met with a minimum total cost, and we do that by constant cooperative planning with respect to the joint use of poles.

The records, in a system of this kind, are a matter of importance, and a voluminous matter. Records of all departments on plats, diagrams and so forth have to be kept up. We have got to have plats to show where all of our transformers are, we have got to have transformer record cards 6638 of each transformer, showing the date installed, every time it has been removed or repaired, and the whole history of it. We have got to have records of every pole and records of all of the permits that are granted for installations of all kinds. The record system is a matter of great importance. That is one thing that I have always been a little bit concerned

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about, the safe preservation of such records. They are so voluminous and they are in constant use all the time that there is no way to put them in a vault like you would a document, and if we were to have a severe fire it would be a great 6639 handicap. Of course, we would keep the service going, but we ourselves would lose a lot of valuable records.

An office division under a chief clerk carries out the various clerical functions, briefly payrolls, material manifests for handling material, records of customers' meters, and many other features.

I think that is sufficient to get an idea of the extent of the records and other office work.

6640 *Stanley Stokes—By Respondents—Direct*

Q. Now, will you describe for us your organization to take care of servicing of customers and breakdowns? A. The servicing of customers' premises at any hour of the day and night, as far as that is concerned, is a function of the operating division of the distribution department which we refer to as the trouble division. It also performs tests, inspections, and patrols of a certain type. It does not do the routine type of patrol that we have discussed previously, but does make special inspections.

6641 The trouble department, which is a rather extensive group, is assisted by the construction division whenever the magnitude of the specialized nature of the work requires it.

In St. Louis County, similar functions are performed, but with slight variations. There is no important difference

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except that they combine their activities out there in a way to give the minimum total cost. The outlying communities in the suburban districts and surrounding counties have emergency trouble service located at the most strategic point, and where the roads are most accessible.

6642 The Illinois operations and the Iowa operations, and so on, are similar. The trouble service itself is arranged to provide for emergency service, 24 hours a day, and requires 28 first class trouble men and supervisors who are experienced and qualified to handle that class of work on either overhead or underground lines of any voltage, or to do work on a customer's premises.

Six third class trouble men respond to house service calls and are in training for higher grades of trouble work. That is, we start the younger men in on the simple work of calling on the house calls.

During 1939 there were 51,639 trouble calls involving service outages or an average of one call per customer every 4 years. Of these, 38,589 were due to trouble on the customers' premises, for which we were not responsible, but which we pointed out and which the customer himself usually took care of.

The average time of clearing trouble calls is 45 minutes, with 50 per cent. of all calls cleared in 30 minutes.

About twice a year a large number of families move, in
any district, and the moving orders and change in location 6644
by customers calls for carefully scheduled meter readings to

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be sure that the billing and all records are kept up properly, and closed at the old address and opened at the new. This movement of the population is seasonal with peaks in the spring and fall, but with very little movement in the winter.

152,347 moving orders to close or open accounts were executed in 1939. That gives you an idea of what it amounts to in an electric company to have everybody move around.

In St. Louis County and outlying districts there were
28,640 such cases. 6645

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Customers' sub-stations, serving the individual requirements of industries, large buildings, hotels, hospitals, theaters, and so forth, receive special attention by periodic inspection and tests to insure good operable condition of all the equipment. Two men with a helper and a specially equipped truck look after 92 customer-owned and 121 Union Electric Group-owned installations. That is company installations.

In addition there are twenty-seven 13,000-volt customer installations inspected by the electrical power plant department. A charge of $25 per year is made to customers who own the installation on their premises, and who contract for this service voluntarily. The actual cost of service rendered has so far approximated double the charge that is made. This would not appear to be a profitable business, but there is more to it than just a few dollars. Every time one of these customer sub-stations gets into trouble it causes
6647 an outage or may cause an outage to our system, and certainly causes an outage to his system, and results in unnecessary difficulties, and if we make a brief analysis of the value or nuisance value, if you want to put it that way, of these cases we think so far that this service is justified. We have found out by experience that the customer himself does not do it, and we have no law that will permit us to compel him to do it, and the best we can do is to try to do it for him, but if we charge in all cases what it costs us, it

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would not be practical and he just would not contract for it.
6648 This service is, in our opinion, still on a tentative basis. I think we have hopes of reducing the cost, and I think we have hopes that the customer might be willing to accept a slightly larger charge. If we can get it on a self-supporting basis that is all we hope.

Q. Do you make voltage surveys to insure the proper service voltage at a customer's premise? A. We do. Voltage survey work has not always been done. I should say this, that over ten years ago it was universal for all power companies to regulate their general voltage standard as the

result of calls from customers who thought their voltage was incorrect.

Today, a considerable percentage of the power companies do some of this work. We have taken active interest in it now for about six or seven years, and are extensively surveying the voltage. One has to be careful when he asks another power company, "Do you make voltage surveys?". I have had an experience. Some times the answer is yes, and when you get right down to analyze the facts, all they are doing is making the usual routine checks that have always been 6650 made. When I refer to a voltage survey, I mean covering all of the major feeders on the system, with a systematic routine survey, using a great many instruments and setting a number on each feeder for a definite period, and then moving them to the next feeder. So that, by taking certain

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sections of the system continuously, we are able to get over our system about once every four or five years on a continuous basis.

The results of those voltage surveys are turned over to the engineering departments to use as a guide for distribu- 6651 tion changes, additions and corrections. That is, these load growths throughout the area are not uniform. Certain districts will start growing at a rapid rate, and also unless you make both voltage surveys and load surveys, you will frequently be surprised. Load surveys are similar to voltage surveys except they measure the loading of the equipment, and try to be sure that they don't overload them. In those surveys we will find some equipment which is underloaded and we can take advantage of that, and move it to some other

location. I don't mean by that, that you can go out and measure the load at every transformer on a system very frequently; you can't do it, there are too many of them.

Q. Do you check customers' range installations? A. Well, yes, we check them very quickly after they are installed. It is essential that an electric range be installed with the correct voltage, and if we give an electric range good voltage, you don't need to worry about the reception that it will get in the home. Inasmuch as we are particularly interested in promoting the sale of the electric ranges, that feature is given special attention.

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Our transformer load survey tries to get around the system about every three years at peak times. Some of the transformers have load indicators installed. It is a peculiar thing that it is not so far different from the standpoint of the loss of equipment whether you have left your surveys alone and just lose the transformers from overload——. We made some calculations at one time to show the actual loss of property if you didn't measure them at all, and found out that that would be less than the cost of making these surveys. But that isn't quite the whole story, and after we analyzed the problem broadly we think the surveys are preferable.

In the first place, you save the outage that occurs when the transformer burns out. In the second place, you learn a lot of other things about your system that are essential to planning.

Among the surveys is an electrolysis survey. I won't go into that in detail because it has been covered twice, but I will say that there are 886 miles of these underground cables which are subject to all of these problems and have to be

watched. It takes an engineer and one field crew of two men continuously.

Also radio interference has become a factor regarding surveys, and we have an expert and a helper whose services are available to customers who complain and think they have radio interference.

About ten per cent. of the calls reported by customers, radio dealers and others, are found to involve some kind of a

condition with which the electric company is connected. 6656
Maybe it is some kind of line trouble or something. About 90 per cent. of them have something to do with the radio sets or some other trouble with which we have no remote connection.

One per cent. of the cases have been tabulated as incipient insulation failures. In other words, a radio will detect any kind of an arc, no matter how small, the least spitting, and whereas ten per cent. of these cases were associated with our lines or equipment, one per cent. of them represented something that may be on the verge of failing.
So that if we catch one per cent. of the incipient difficulties, 6657
we probably save many failures. This is not only a service to the customer, but is probably an economy to ourselves.

Then there is a type of radio interference that we didn't used to know much about. If a 33,000-volt circuit happens to be within 30 or 40 feet of a highly sensitive radio, even a well designed circuit may be picked up a little bit. It is due to the slight amount of corona or incipient spitting—you can't see it and you can't hear it, but it has to do with the tie wire and the insulator. The solution to that is where those troubles are observed, to use some special form of insulator

which has a slight conductive coating at the point where the tie is attached.

They have a lead glaze they put on the insulator and spread it out, and that makes the contact with the porcelain

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a larger area, whereas the tie wire is a concentrated contact at one point. The result is that we have been able to eliminate those things and there aren't very many of them anyhow.

6659 Telephone operations have been discussed to a large extent.

There is a special telephone board in the distribution department headquarters that fills a room about this size, and it is operated in connection with the trouble dispatcher's office and also has connections to the load dispatcher and his men.

That is a rather brief summary of those operations.

I attempted to avoid covering extensively the same subject that we had treated on the higher voltage lines.

Q. Does the Union Electric Group derive benefits from
6660 the interchange and pooling of technical information with other companies in the North American System? A. Yes, it does. The Union Electric Group has derived very substantial benefits and economies over the years from pooling of technical information with other companies in the North American System. Such benefits are derived not only from the normal contact through system committees on which various companies are represented, but also through less formal and direct contacts between particular companies.

Q. Does the Union Group interchange statistical data with the other companies of the North American System?

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A. Yes. The Union Group receives monthly reports giving detailed operating data and itemized production expenses for each of the large steam generating plants in the North American System. Thus it always has before it the record of performance of the other companies' plants.

Q. Are coal samples interchanged among the companies? A. Coal samples are interchanged each month in rotative order, each company sending out a representative plant coal sample for analysis by the other company laboratories. At periodic intervals a check test is also made by the Bureau 6662
of Mines.

The results of these analyses are tabulated and a comparative statement sent to the various companies. This procedure serves the two-fold purpose of providing a check on the technique of individual company laboratories, and also gives accurately the heat content and analysis of the fuel used by the respective companies, this latter being an important factor in calculating plant thermal economy.

Needless to say, it also makes available to each company complete data on the fuel used by the others, and fuel is the most important single element of operating or production 6663
costs.

Q. Through this interchange of information with the other companies, does the Union Group receive consulting services on design for plant expansion? A. Yes, we do. Whenever one company is considering a new plant or an ex-

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tension to an existing plant, the entire proposed layout, including all of the design features and selection of equipment, is submitted to the engineers of all the other companies for their comments and views.

This furnishes a unique consulting engineering service which could not be duplicated anywhere else in the country, due to the fact that there is no other associated group of utilities serving major cities of about the same size, and with comparable steam generating plants and comparable problems.

Q. Is the result of this interchange of information the avoidance of duplication of research? A. Well, naturally it does avoid duplication of research because, since the
6665 engineers of all of these companies are available for advice to each company and since the developments in each company are communicated to all companies, in effect, each company has the benefit of all improvements in engineering technique developed by all companies.

Again, there is a unique service because of the fact that the companies are of comparable size, so that their problems bear more relationship to each other than any other associated group could have.

Q. Are the consulting services of the other companies' engineers which are so made available to you made more
6666 valuable by reason of the familiarity of those engineers with your system? A. Yes, it is obxious that the engineers of

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each company are familiar with the plant and equipment of each of the other companies since meetings are rotated at various companies, and at these meetings inspection trips of the equipment are made.

This information is in addition to the statistical information which they have received otherwise. Obviously again, the value of the intercompany consultations is tremendously

increased by this background of knowledge, which is thus afforded.

Q. Will you please give us some examples of benefits which have accrued to the Union Group through these inter-company contacts? A. Well, there are typical examples which I might cite of the benefits which have accrued to the company from these companies, one of which has to do with pulverized fuel.

It is typical and outstanding in the design of all of the
plants of the Union Electric Company of Missouri that we 6668
do use pulverized fuel, pulverized coal for fuel. The first station in the country to demonstrate the numerous advantages of this method of firing was the Lakeside plant in Milwaukee in 1920 to 1922, following earlier experiments in that city of the Oneida Street station. This development at the Oneida Street station is an outstanding achievement because it marked the beginning of the use of pulverized fuel in this country.

At this time the Union Electric Company's Cahokia station was being designed for chain grate stokers, the only

reasonably effective method for burning Illinois coal then known.

By close contact with the Lakeside experiments and tests and by testing several cars of Illinois coal in their furnaces, which had been shipped to them for this purpose, we early realized that this method would be ideal both for the type of coal and for the operating conditions imposed at the new proposed Cahokia plant. It was decided to use pulverized fuel at this plant, and it became the second station in the country so designed.

Pulverized fuel firing has been a great boon to the Union Company system. Illinois coal has been burned on every type of advanced stoker design at the Ashley Street plant, but the characteristics of this coal had limited the performance and the result in every direction. Its high ash content, low ash fusing temperature, and clinker forming properties had limited the boiler ratings to 225 per cent.

That perhaps might sound like a high rating, but it is not.

6671 The large amount of clinker and ash refuse carried off by the unburned coal reached a point where 20 per cent. of unburned carbon in the refuse was common. The size of the steam boiler units was limited by the physical dimensions in which it was possible to build stokers, with the result that Ashley Street station had 56 boilers for a plant capacity of only 122,000 kilowatts.

The extremely slow response of a stoker fire to changes in

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boiler load imposes a severe strain on equipment and personnel in an effort to maintain constant steam pressure un-
6672 der rapidly fluctuating loads of a utility system which serves an industry, a street railway system, whose peaks are rather sudden, and which is operating in conjunction with a hydro station.

Finally, the high volatile content of Illinois coal resulted in serious smoke production, which adversely affected economy, and became a problem in the community where smoke was already a recognized difficulty.

Pulverized fuel has been an important contributor in the steady progress toward lower production cost, and the con-

sequent cheaper rates are offered by this company. Instead of the 20 to 35 per cent. unburned carbon in the refuse, this figure is usually from 2 to 6 per cent. today.

Boiler size now appears to be limited only by the quantity of steam desired in a single unit.

In 1922 Ashley Street had a boiler for each two point two thousand kilowatts. Cahokia, placed in operation in 1923, was able to supply twelve point five thousand kilowatts per boiler. The new Venice No. 2 plant now being erected has 40,000 kilowatts per boiler. Further, pulverized coal firing 6674
so adequately meets the steam requirements for rapidly swinging loads that combustion control is handled with automatic equipment, with operators giving technical supervision.

Finally, even with 37 per cent. volatile coal this is done

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with a minimum of smoke.

Through the experience gained by our sister companies with extremely high pressure and temperature steam, our company was able to choose steam pressures and temperatures consistent with our operating conditions. The value 6675
of the studies consisted of the determination of the upper limit of steam temperature from which designers were able to devise the heat cycle leading to the highest steam pressure consistent with the greatest fuel economy.

Knowledge of creep stress of alloy steel piping, turbine blades, and valve parts was not well understood. There was very little knowledge on that subject. Perhaps I should explain there that if steel or alloys are subjected to very high temperatures over a period of years, they seem to expand

6676 and occupy more volume permanently. In other words, whenever they are heated up and expanded they do not seem to contract to the exact same volume that they origially occupied, and the extent to which this creepage will take place at high temperatures was very much in doubt. As the result of this high temperature work actually carried out in power plants, an upper limit of 925 to 950 degrees of steam temperature was established as an upper limit for currently available materials. It is a general practice, 6677 I believe, to stay a few degrees below these limits. For example, a 925-degree design would correspond to this 950-degree limit. By staying at 900 degrees there is a fairly good factor of safety today, taking into account the present-

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day knowledge. But without some of this research that knowledge would not have been available.

Thus with the work by our sister companies on high steam pressures and on high temperatures, the very likely error of going over 850 pounds pressure and 950 degrees temperature for our new Venice No. 2 plant, with the St. 6678 Louis type of fuel and the load strains due to parallel operation with distant hydro plants, was avoided.

I would like to make an explanatory note there, that it would have been a simple error to fall into because that type of plant could have been successfully operated elsewhere and might readily have been assumed to be equally successful with our coal. Improved knowledge on that subject shows that that would not have been the case, that our conditions were different.

Thus, through this work by our sister companies on high steam pressures and high temperatures, this error was

avoided. Furnace designs at Cahokia, Ashley Street and the new Venice plant all reflect the guidance of the other companies.

For example, early furnaces at Cahokia resulted in furnace maintenance work costing an average of 11 cents per ton of coal fired. Through the experience of the other companies, all of whom were thoroughly informed of our operating conditions at Cahokia, a water wall construction was developed that reduced this cost to three cents per ton.
A development of great economic value to the St. Louis 6680

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plant has been that of improved furnace and pulverized fuel burner designs, suited to the low grade coals available in this section of the country, at the same time permitting a high rate of furnace heat relief. By that I mean a large number of B. t. u. per cubic foot of furnace volume. Although the ash of the coal burned becomes molten at the comparatively low temperature of 1,950 to 2,100 degrees. In the period from 1926 to 1928 it was found possible to double
the output of furnaces from 12,000 to 24,000 B. t. u. per 6681
cubic foot per hour. This development permitted doubling the output of several of the Cahokia boilers, and this in turn permitted the installation of a 75,000-kw. turbo-generator in the same space supplied for the boilers originally provided for a 35,000-kilowatt turbo-generator.

That, by the way, is the No. 1 machine today, and refers to the 35,000-kilowatt machine which was removed and installed in the Venice plant. That has been mentioned heretofore.

In this development, the combined knowledge of all companies sitting in on bi-monthly meetings permitted verifying and modifying this development at every stage. The final result was the successful installation that required not a single substantial change after designs were drawn up and the units placed in operation.

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Fly ash collectors have previously been discussed at considerable length. They are just ready to be tested at our
6683 Ashley Street station, and are being installed for one section in the Cahokia plant. This application has been tremendously aided by the coordinated work of all companies keeping each other advised on such related problems as the design and performance of collectors and the handling and utilization of the fly ash material which is collected.

Q. Could you give us some typical examples of benefits which have accrued to other companies using the North American system by virtue of the development by the Union Electric Company? A. Yes, I can cite such examples.

The first major development in pulverized coal firing,
6684 after its adoption at Lakeside and Cahokia, has been of greater simplification by the use of pulverizing mills, firing directly into the furnaces. This method is known as the unit mill type of firing, as distinguished from the original central system in which the pulverized coal is first delivered to the bins from which it is taken as needed.

This method of firing was developed for the central station as Union Electric's Ashley Street power plant in the period from 1924 to 1926. Its advantages are simplicity, economy and safety. It eliminates the storage of pulverized

coal and reduces the quantity of pulverized coal in the plant at any one time from several hundred tons to a relatively few pounds.

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This leads to a far safer condition since practically all the hazards with pulverized fuel occur where there are accumulations of coal.

Further, costs are reduced both in initial investment and in operation because of the elimination of fires, the separation of coal, pulverized coal and air, as discharged from the 6686
mill preparatory to transport, and the transport of coal with compressed air to the bins, and then the second separation of air and coal at the bins. Also, the screw feeders and the mixing of coal and air for the purpose of introducing fuel into the furnace. Those are all eliminated.

Throughout the period of the development of the unit mill system, all companies kept in close touch with the project. These companies sent representatives to Ashley Street to study the changes being made, and to witness the extensive performance tests.

On the basis of this knowledge, Cleveland and Washing- 6687
ton were enabled to develop a unit mill application for their own plants which have contributed to the extremely economical operation which has been developed in those cities.

Another item which must be mentioned is the fact that after turbines have been operated over a period of a year or two, the blading becomes covered with a hard layer of scale which arises from the impurities not eliminated from the water. This scale changes the shape of the blading and generally impairs efficient operation. It also covers up defects

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in the blading and prevents their detection. Hence, when turbines are shut down for periodic overhaul, this scale must be removed. The use of the sand blast method, employing fly ash, introduced by the Union Electric Company, Missouri, and their group, has proved to be efficient, non-injurious to the blading, and very economical, and has been adopted by other companies with like results.

Q. Are inspection trips frequently made by the engineers of the Union group to observe new installation in the other
6689 companies in the North American system? A. Yes, inspection trips are carried out with regularity. Trips are made to one company by the engineers of the other companies, whenever there is a new system installation, so as to obtain first-hand information on design features and to observe the physical and operating characteristics of the equipment.

Q. Is information relating to current problems freely interchanged by the companies? A. Yes, there is a very free interchange of such information. Interchanges of information are carried on by correspondence. The engineer of one company will address those others concerning a certain
6690 subject, outline his company's practices, and request similar information from the others. Their replies in turn are sent to the originator, and the engineers of all other companies, so that the complete story is available to all. At the next meeting such matters are usually further discussed to clarify

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any doubtful points.

Q. Are growth statistics interchanged at regular intervals by the several companies? A. Yes, at regular intervals analyses are made of the growth trends in the system output, maximum system demand, and number of electric customers

for each of the companies. This gives an index of general business conditions in the various localities, and comparative study is helpful in forecasting the long term capacity needs.

Q. Are electrical system performance data interchanged by the several companies? A. Yes, the electrical system performance data is interchanged. Annual data on system electrical losses and efficiencies are submitted for study. By "annual data", I mean 12 months ending with the current
month. That data is interchanged usually more often than 6692
once a year.

Q. What do these data show? A. These data show comparative efficiencies in each of generation, transmission, conversion or transformation and distribution components, and overall operating efficiency of the system as a whole. The resultant discussion of specific features of system design accrue to the benefit of all companies.

Q. Do the several companies interchange information on circuit interruptions, and equipment failures? A. Yes, company data is exchanged on circuit interruptions and equip-

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ment failures. This data is compiled in comparative curves to show the continuous 12 months' running performance record. This study is giving each company the benefit of the experience of the other companies, and has in many cases prevented serious trouble by giving advance information of defects in equipment, switching arrangements, or operating procedure, so that the other companies could anticipate similar experiences and make corrections to avoid such failures.

I could indicate the variety of subjects on which such service records are interchanged, and among them I could mention the circuit trip-outs. By "circuit trip-outs" I mean the tripping of an oil circuit breaker supplying a feeder.

Then, cable failures. That is a comparison of cable failure records at different voltages, and per hundred miles per year, or on some such similar basis.

Transformer failures; circuit interruptions; fuse failures; fuse box failures; wood pole failures; distribution wires down. That is a sample of the type of information that is interchanged.

Any tendency on the part of one system to develop more failures than the average, at once becomes apparent, and the group of engineers of all the companies, acting as consultants, is in a unique position to determine the cause.

Conversely, any exceptionally good performance is available for analysis and example. Through such closely related inter-company activity, the service dependability of all companies has developed to a high level.

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Q. Is information interchanged on operating problems? A. Yes, information on company operating and even on maintenance problems and on standards of maintenance practice, is interchanged and new developments in system design are frequently interchanged between the various companies. This is done not only at the regular meetings, but also by correspondence between meetings. There has been a particular benefit in the interchange of construction and equipment standards and specifications. These are based on a combination of test data and on a long accumulation of experience.

Close cooperation among the companies, with ready and frank criticism exchange in the security of their family relationship, results in the development of a class of standards and specifications which would not otherwise be possible.

Q. Have there been any cooperative investigations on various subjects? A. Yes, there have been various cooperative investigations.

To aid the companies in reaching accord on various matters, studies, designated as objectives, have been assigned to the different companies, and an analysis which took into 6698
account all of the factual and theoretical data available has been made and presented. At least 20 such objectives have been investigated.

Q. Could you give us some examples? A. Examples of such objectives might be, or are, rather, proper voltage to

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use for A. C. distribution; size of load to be taken on the system at transmission voltages; methods of fighting generator fires; what is the best method of locating high tension cable breakdown; when are automatic A. C. sub-stations justified;
6699 what are the factors and relative weights, affecting the most economical size of A. C. and D. C. distribution sub-stations for suburban service; a determination of the electrical instrument necessary and desirable on equipment of all kinds in power plants, sub-stations, lines, and feeders; economies in repair of distribution transformers; protection of high voltage transmission systems by overhead ground wires, flux control and grading shields; study of the most economical size and type of direct current feeder cable for Edison system; minimizing cable reel losses; economies of cable sal-

vaging; investigation as to the advisability of the use of factory-made bus structures. Those are representative examples of the type of assignments that have been made.

Q. Can you give us examples of developments in the field of transmission and distribution which Union Electric has participated with the other companies? A. Yes, the swinging cross-arm transmission structure, and the design of an improved type of "H" frame wood pole construction, which has been previously presented here, are examples of that type of
6701 cooperative design.

Several of the cities of the North American group are in geographical sections subject to frequent lightning storms. The St. Louis group made these studies to which I have re-

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ferred, and which have been discussed at length heretofore, and they conferred with the other companies as the plans were developed.

The basic design of these two lines was checked by all companies, and we had the benefit of their views. This pool-
6702 ing of experience is in no small degree responsible for the most exceptional success of these two lines in resisting interruptions due to lightning.

One item of development recently by the St. Louis group is an inexpensive meter for measuring maximum, minimum and average voltage at any point on the system, and in particular on service connections. Through closely regulated voltage and particularly in control of maximum and minimum voltage, marked improvements are possible in the efficiency of the utilization especially in lighting service.

Judging by the interest shown in the new instrument, it will be used extensively in making the voltage surveys previously referred to.

The use of carrier current communication methods has been an important advance in load dispatching, and the application of these methods in the Union Electric group has been aided materially by the cooperative opinions and advice of the various companies.

This installation was the logical outgrowth of pioneering work by the company engineers, together with later advice 6704
and assistance from an engineer of the North American Com-

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pany. The equipment is in regular use in load dispatching over the entire system. Automatic sub-stations have been a particular field in which the St. Louis group of companies has pioneered, particularly in the use of controlled circuits.

An example of a load-shifting device which automatically divides the load between two machines on a predetermined basis, was referred to in our previous description.

That device also will automatically shunt the load to other machines when one is shut down. 6705

The ground relays on induction voltage regulators have also been mentioned. These relays prevent the circuit from becoming reclosed in the case of regulator trouble. The other companies in this case were enabled to learn of the merits of the arrangement almost as soon as it was installed and tested, an advantage which would not have been available were it not for this intercompany cooperation.

Another subject on which attention has been recently focused is that of immediate versus delayed reclosing of cir-

cuit breakers, at the time of a system short circuit fault. It was found that relatively few circuits stay closed, that is in operation—with instantaneous recloses. Nevertheless, it offers superior overall performance to the customer, since with instantaneous reclosing the service is not interrupted, whereas with the service off for five seconds or more some of the customer's equipment would be shut down.

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The Union Electric group made a special study of this
6707 development and in conjunction with Mr. Wallau, a Cleveland Electric Illuminating Company engineer, reported the benefits and limitations to all companies. We mentioned the thermostat among our description of automatic sub-station pioneering. That was one of the items which the St. Louis group made available to the other groups. The thermostat applications have also been used for automatic control of the cooling water on transformers as well as for the other applications which I have previously mentioned. That type of development is passed around to the other companies at the first opportunity, which is usually shortly after it is
6708 developed.

The Union Electric Company also was one of the first of the companies to adopt measurements of dielectric loss and insulation power factor as the index of the condition of the dielectric.

The company's present policy is to periodically test by this method all bushings, transformers, potential devices and oil circuit breakers above the 10 kv. classification. Tests are also made on certain cables, potheads, and lightning arresters.

Without the intercompany cooperation, such rapid and beneficial response to outstanding improvements such as this, could not have been effected.

All companies have interchange of experience data and

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testing procedure for lightning arresters, and this work has been the basis for the establishment of a definite policy for the design and application of such arresters. In this case the Union Electric group were the beneficiaries. We had some difficulty with some lightning arresters in the last two 6710
years, and got some very valuable information from the other companies.

Another distribution development which is currently being studied and developed is the general subject of service connections to domestic users. A rapid increase in the use of electric cooking ranges has brought this subject to the fore because of the improvement which can be effected, particularly by the use of the outdoor meter and enclosures, and simplified wiring connections. Savings are possible by development of new wiring systems, materials and methods, all of which pass through some experimental stages. By 6711
pooling their experiences, the associated companies have available data from which their procedure can best be directed and also assure minimum wiring costs to the customer.

Union Electric group has been studying the method used for service connections by their related companies, and have greatly benefited by a knowledge of those changes which have proven to be desirable.

The trouble department of Union Electric group, particularly the St. Louis division, is being remodeled on the basis

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of experience gathered from the other companies. This change

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also includes the subject of radio communication for emergency dispatching in case of transmission or distribution trouble.

Another item of considerable moment, because it has been the source of some rather extensive lawsuits, is the noise from transformers. This transformer noise causes complaint at certain locations from the public. These complaints
6713 originate in residential neighborhoods, which are in the vicinity of large power transformer installations. I should say that the lawsuits to which I refer did not occur in our system, but we had such complaints of difficulties and recognized the responsibility might turn out to be with us.

The noise may be described as a low-pitched, steady humming which becomes objectionable during the night period when the general noise level has subsided. Mutual investigations among the companies have been helpful upon this subject. These included, for example, procedure for making noise measurements and writing the specifications
6714 covering noise for the purchase of equipment, particularly transformers. As a result, three transformers now on order have been designed for an appreciably lower noise level.

Q. Can you give us an instance in which the Union group have loaned personnel to a sister company? A. Yes. Our group loaned to the Milwaukee company the services of the sales manager, Mr. C. D. Michel. He was the sales manager or is the sales manager still, for the Union Electric group.

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He was loaned to the Milwaukee company and completely

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reorganized their sales effort. Mr. Michel was at that time, and still is, a leader in the field of sales promotional work.

Q. Can you give us an instance where the Union group has borrowed personnel from a sister company? A. Yes, the Union Company has just recently obtained the services of a member of the staff of the Potomac Electric Light & Power Company of Washington, ~~Mr.~~ William Jones, who is an expert on customers' record filed.

We also borrowed Mr. Campion, a consulting engineer of
the Potomac Electric Light & Power Company, to give us 6716
consulting advice and assistance on the foundation work for Venice plant No. 2.

Mr. Campion is a recognized foundation expert, and we called him in, in connection with our piling and foundation work for the new turbine.

Q. Can you give us an instance in which the Union Company has sent its personnel to a sister company to investigate their practices? A. Yes. Only recently the Union Company sent members of its organization to Milwaukee to study the reasons for the remarkable reduction in building costs
which had been achieved by the Milwaukee company. 6717

Q. Does the Union group feel free to call on other com-

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panies in the North American group for help? A. Yes, we are very free to do so. Whenever any problem arises as to which we wish the combined experience of the other companies, or the experience of any other single company, we feel entirely free to write, requesting such information, even though we know it may require cosiderable work to answer our inquiry. We feel free to do so, because the other com-

panies are in the family and they are equally free to write to us. We feel equally free to give information within the family. There is much of this informal exchange of information. This relationship simply does not exist outside of the family group.

Q. Now in the meetings of the engineers of the companies in the group, has the size of the group any bearing on the extent and nature of the information interchanged? A. Yes. I consider that it does. The smallness of the group
6719 makes it possible to arrive at results which would be impracticable in a large industry meeting, and the smallness of the group is one of the essential factors in deriving the most benefit and it distinguishes this intercompany work from other professional aid which we receive from other contacts. This little group, you see, is not only small, but well acquainted.

Q. Does the gross relationship within the group contribute to the freedom and frankness of the interchange of information? A. Unquestionably. We know that we can ask any question of another company within the family, and get
6720 a completely frank answer, just as we give any information

requested without reserve to any other member in the family group.

This element of frankness is unique and entirely restricted to these family relationships. In other words, we would not and could not give information with anything like the same degree of frankness to any outside company, nor would any outside company expect it, nor would we expect such frankness of them.

Q. Do savings and economies result from these inter-family contacts? A. There is no doubt that the Union group, and each of the other companies, derive important savings and economies in the aggregate from these inter-family contacts. Naturally it would be difficult to put an overall dollar valuation, but certainly the savings are most important and make a large contribution to our efficiency.

Mr. Odell: Just as a matter of information—and this may have been previously answered—do you attend these meetings that you spoke of a while ago? 6722

The Witness: Yes, I have been a member of the intercompany electrical committee for many years.

By Mr. Browning:

Q. Is your meter reading group an important customer contact group? A. Yes, it is, and in analyzing some meter reading costs which I had occasion to go over, it was very evi-

dent that we were hiring more intelligent and attractive men because of the value that we know that they have to the company in its contacts with the customers. In fact, they are 6723 about the only contact that the average customer has with the company, and the attitude of the meter reader frequently, in the customer's mind, sets out the kind of a company you have, and it is desirable to have high-grade men. Of course it goes without saying that they have to be honest.

Many customers send payment of their bills through the mail, and seldom contact any representative of the Union Electric Group except the meter readers. Others pay their bills at the multiplicity of pay stations to which previous

reference has been made. The meter readers are therefore selected on a basis of their judgment, tact and ability to meet customers. They must conduct themselves on a customer's premises in a manner reflecting the company's desire for good customer relations.

Q. Can you tell us something about the functions of the meter reader? A. A meter reader has to first read meters once a month, he has got to record the readings on the individual customer meter route sheet. He has got to sub-
6725 tract the current readings from the previous month's reading, and compute the current month's consumption; we check the reading if the consumption appears too high or too low; attempt to account for fluctuations if recheck shows that the reading is correct, by inquiring of the customer and deter-

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mining that the meter is registering mechanically; report service complaints or comments by the customer; also notices of moving and other matters which require further handling; execute re-read orders and special read orders received from the billing division, credit, adjustment, and collection divi-
6726 sions, sales department and other departments contacting customers. That is, they may call for a re-reading for any one of a large number of reasons.

Q. Will you describe the work of meter reading? A. Yes, the meter reading in the early days of both the telephone and the electric companies was always carried out on a certain day of the month. Of course that became impossible after the company grew so large, and the billing districts and meter reading districts are made up now so that the reading is continuous every day of the month. That not only

equalizes the work on the meter reader but on the accounting department and other departments. I have forgotten how many sections we have, but I think there are some 23 or 25 billing districts, something on that order.

Q. Are the territories served divided into districts for this purpose? A. Yes, in other words they divide the territory up into these various meter reading districts, which we usually refer to as billing districts, and the bills are sent out at regular intervals so that the customer in a given district always gets his bill about the same day of the month, each 6728

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month, but he won't get it the same day that some other customer does. In other words, we will bill district No. 1, for example, on the first of the month. District No. 5 may be billed on the 5th of the month, and so on. It is a continuous performance because it is impossible to either read the meters or bill 350,000 customers on any one day. All big systems do that today.

I believe that we—I know that we did for several years—read the meters to the nearest even kilowatt hour, except on final bills, which are then read exactly. That is a means of 6729
eliminating half of the numbers that had to be dealt with. I think that advantage has disappeared though, with the use of the machine billing, and I think they are now read as they read. There would be no loss if you just read to the nearest kilowatt hour, and if your final bill is rendered accurately nobody has either gained or lost. It simply happens that we used to use a rubber stamp system, and that cut the total amount of work about in two. But with machine billing that probably has no further advantage.

Q. How many electric and gas meters are read monthly? A. Well, they read them all, but at this particular time—I had that figure looked up, and it was 356,492. That is probably a little different today, but that was at the end of December.

Q. In addition, are inactive meters checked? A. Yes,

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there is always a lot of re-checks, and they ran 28,000 on the inactive meters. You see, we leave those meters in the
6731 premises when people move so that they can obtain service as soon as they get into the house, but we have got to check on those to see whether anybody has moved in, and also to see that the meter has been used. Meter readers compute the consumption of the accounts other than commercial, which are machine billed, by subtracting the previous month's reading from the current reading. This eliminates an operation in the office and calls to the meter reader's attention the unusual fluctuation of any customer's bill while he is still on the job. In other words, he makes the computation and he will check anything in error, either he may have read
6732 it wrong or it may be an unusual use. If he catches that before he leaves it will save a re-check and return trip.

These meter readers also execute a large number of requests for re-reads, as mentioned above, and special re-read orders where some group in the company needs the information, either suspecting that the reading isn't correct, or for any other reason wants it re-read.

One of our major difficulties in reading meters has always been that the customers are away from home, and you can't get in, and if you do make a meter reading through a basement window, the customer always complains and perhaps

says that you didn't read the meter at all because you couldn't have gotten into the house, and we have had to send a meter

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reader back out to show him that he could read the meter through the basement window.

But the real difficulty, when meters are located inside a house, is that so many trips have to be made back to a house on account of a customer being away. That is the advantage, or one of them, of the outdoor meter. If he can't get at the meter to read it on his scheduled call he leaves a card which 6734
requests that the customer mail it in, and if he doesn't get that he will make another attempt to read it.

About 25,000 of these "Read Your Meter" cards are left at customers' premises every month of which roughly 70 per cent. are returned by the customer. Consumption on the remaining accounts, for which no readings are obtained, is usually estimated, with the exception of commercial customers. These estimated readings are of course automatically adjusted when the next regular reading of the meter is taken.

Q. Do you devote attention to reducing the cost of meter 6735
reading? A. Yes, we try to keep the cost as low as is consistent with the duties that we ask the meter reader to perform. I have listed some of those duties. In our force of 74 meter readers, who now not only read the meters but perform the other items which we have discussed, they take care of the metropolitan St. Louis, St. Louis County and four adjacent counties in Missouri, as well as certain areas in Illinois including East St. Louis and Alton, a small terri-

tory in Iowa, and including the city of Keokuk, Dallas City and Fort Madison, all in Iowa. The total area is about 3,100 square miles.

The cost per customer of reading these meters and handling the other re-reads and doing the work itemized is about 45 cents per customer. In example, in the year 1939 the expenditure was $161,284, representing a cost per customer of 45.2 cents. This cost varies within limits from 40 to 45 cents, depending on varying conditions.

6737 The accounting has a little effect on it, the question of whether you allocate your heat, lights, building expense, air conditioning, and things like that to the bill work, or whether you keep it in a separate account and set it up by itself. Some people do it one way and some the other. In our case, we allocate all the expenses in the billing division to the billing, and credit the collections to such items, in other words distribute the expenses of the office, even to the extent of the cost of the air conditioning.

Q. Do your customer billing departments have an effect on good customer relations? A. Did you say the customer
6738 billing departments?

Q. Yes. A. Well, to the extent that our rates are low, I should say that the customer billing departments would have a good effect. I know that the meter reading and the people that are in contact with the customers do have a good effect.

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In other words, our relationship with the customers is extremely good. The contact is principally through the meter reader, himself. We have a department which takes care of customers' service calls, and we try to be as polite and courte-

ous as it is possible to be, and to the extent that I have had contacts with that division—I used to be very closely associated with a division of that work—I feel that the customers are well satisfied with the service that the company renders, and I think most of them are pretty good friends of the company.

Mr. Browning: We have now reached a good stopping point, Mr. Examiner, and I suggest that the hearing be adjourned until Monday morning.

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The Examiner: I understand that you are going to continue next week with Mr. Stokes, is that right?

Mr. Browning: With Mr. Stokes and possibly other witnesses, that is right.

The Examiner: All right, I think that is a reasonable application, and the hearing is now recessed until next Monday morning at 10 o'clock.

(Whereupon, at 4:15 o'clock, p. m., the hearing was recessed until 10:00 o'clock, a. m., Monday, October 28, 1940.)

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6742 BEFORE THE

Securities and Exchange Commission

Docket No. 59-10

IN THE MATTER

of

THE NORTH AMERICAN COMPANY, *et al.*

6743

Hearing Room 1101,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Monday, October 28, 1940.

Met, pursuant to adjournment, at 10 o'clock a. m.

6744 Before: W. W. SWIFT, *Trial Examiner.*

Appearances:

S. PEARCE BROWNING, JR., and CHARLES S. HAMILTON, JR., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for the Respondents.

RALPH C. BINFORD and HERMAN ODELL, Attorneys for the Securities and Exchange Commission.

PROCEEDINGS

The Examiner: The hearing will come to order.

Mr. Hamilton: Will you resume the stand, Mr. Stokes?

Whereupon, **Stanley Stokes** resumed the stand and testified further as follows:

Direct Examination by Mr. Hamilton (Continued): 6746

Q. Will you refer, Mr. Stokes, to Respondents' Exhibit No. 54. Last week you undertook to get for us the basis for the caption heading appearing on that exhibit, and stated as being the "B. t. u. per Switchboard Kilowatt Hour". Please state whether the kilowatt hours referred to represent net output or gross output? A. Those are net output. I had the figures verified and checked them carefully.

Q. This represents, then, net output from the generating stations? A. That is right.

Q. At the conclusion of the least hearing, I believe you were describing the billing and customers' accounting procedure. Will you explain how electric bills are prepared and distributed among your customers? A. Each month the bills are rendered to 349,019 electric; 7,473 gas; and 316 steam customers. Those figures, of course, change monthly, 6747

by slight amounts, but that is the approximate amount or extent of the billing operations.

Individual customers' accounts are maintained and all charges and payments are kept currently posted. The ob-

jectives, of course, are to get bills out promptly and not delay the customers. The customers like to receive their bills regularly; when they get used to a certain date, they want to get it on that date.

To provide accurate and current record of customers' accounts, at all times; to maintain good customer relations, by making the records available to departments who answer customers' inquiries and to perform these operations at the lowest possible expense.

6749 The names, addresses and folio numbers, where used, are embossed on metal addressograph plates, and filed in district order. By "district" I mean the billing district, the various territories having been divided up into individual districts, called billing districts.

The group that does this work also heads up all new customer ledger accounts, and meter reading route, and prepares the semi-monthly payroll sheets, and in addition to that addresses dividend payments to the stockholders of the Union Electric Group.

Other work which the mailing and addressing department
6750 does includes the sending out of the Union Electric Group's monthly magazine; preparing a portion of the

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periodic meter test orders; addressing advertising material for the sales department; and any other work requiring the use of the addressograph equipment.

The plate-making operation is carried out on what is known as an addressograph-graphotype machine, and a voluminous addressing operation is accomplished on the addressograph equipment built for that purpose.

Customers' bills are addressed on a district basis just prior to the district billing dates, so as to reflect all changes in customers' names and addresses made during the month. This group cooperates closely with the billing group in maintaining the schedule set up for rendering bills.

Q. What are the subdivisions of the billing and customers' accounting division? A. Well, I take it that you refer to the district separation or division? That is, the billing district, which starts out by representing a given territory which
the meter reader covers, is the basis for all the succeeding 6752
operations, because the meter-reading sheets and records are followed by billing and accounting records, all on the district basis.

You see, it would be a practical impossibility with so many customers to get out all bills on one day of the month for the entire number, or to read all meters as of one day of the month; it simply couldn't be done, so they are broken up into continuous operations, so that one district is billed

on, say, the 18th of the month, and another on the 20th,
and so on. So that the performance is a continuous opera- 6753
tion, and the month's energy as reported as kilowatt hours sold, is just an arbitrary cutting-off point, once a month, on this billing operation.

Q. Now, state whether you have a customers' record division, and if you have, explain what its functions are? A. Well, the chief functions of this customers' record division which we do have, are the opening of new ledger accounts for customers when service is connected, and closing the account when service is discontinued. Also, the preparation

of monthly bills to customers, the maintaining of accurate records of customers' accounts.

This group opens the customers' ledger accounts from the record of service applications, contracts, or any other source indicating the fact that the customer has started to use service. It closes these accounts upon receipt of executed disconnect orders.

If a new service order covers a new premise, it is necessary to insert a new meter route sheet in the meter reading
6755 book. If, however, the order covers an old premise, the new order is entered on the existing meter-reading sheet unless there is a change in the class of service.

New ledger sheets are made up on all orders except those

—2,874—

involving change of load or rate, corrections of load, and meter changes. This group also enters the change of rate data, meter changes; merchandise, lamp and sundry charges, and all other billing data pertaining to customers' accounts.

The amount of such entries annually was: 107,686 applications for service; 161,022 appliance charges; 137,673
6756 lamp and sundry charges; 107,254 disconnections of service. Those figures were taken for the past year, but that is just an indication to show the extent of the work.

The residential and small commercial accounts group transfers meter readings, prepares and proves the monthly bills to customers on the rate schedules, and accumulates revenue and statistical data required on these operations.

The large commercial and industrial special contract group enters demand readings and manually prepares monthly bills for the larger accounts. The volume of the

large accounts does not warrant special billing equipment as is used on the residential and other types.

Many of these bills are based on meter readings taken at the end of the month, instead of at the regular district scheduled reading dates, so that the billing period will correspond with the calendar month to meet the customer's accounting requirements. These large customers are big industrial firms, and they have their own accounting problems to meet, and have requirements for making reports on calendar dates,

—2,875— 6758

and as long as there are not such a huge quantity of them, we make every effort to meet their requirements by making special meter-reading periods for them.

This same contract group, also manually prepares bills for the steam service in the business section of St. Louis. Steam meters are read at the end of each month by the steamheating department and bills are rendered promptly after readings are received.

The annual production of the above billing groups consist of: 3,303,154 electric bills mechanically prepared; 885,-
102 electric bills manually prepared; 3,793 steam bills man- 6759
ually prepared; and 89,659 gas bills manually prepared.

Those gas bills are for the St. Louis County Gas Company, which is a separate company, but operated with the same help and facilities.

In the areas where the billing operation has been mechanized, Burroughs Public Utility Billing Machines are used. These machines simultaneously print the bills, record the charges to customers' ledger accounts, and produce a tape showing accumulated totals, which provides an efficient method of proving the billing operations.

The bills are set out on ordinary United States one-cent post cards, which are sent to the printers, where the various bill forms are imprinted on the cards.

The bookkeeping section posts and balances customers'

—2,876—

accounts, maintains the accounting controls, and prepares journal entries to record customer accounting transactions. This group is responsible for sorting and posting cash stubs received daily from the cashier's division to the individual
6761 customer ledger accounts. Postings are made by date stamps imprinted above amounts paid, requiring minimum posting time. All posting is proved by comparison of adding machine totals of items posted out, with adding machine tape totals of the cash stubs received.

Also, in their duties is included the maintaining of accounting controls on all customer ledger accounts, including large commercial, steam and gas accounts.

Further, they are engaged in preparing journal vouchers recording revenue from electric, merchandise and steam sales; charges to uncollectible accounts; transfers and ad-
6762 justments; and any other entries affecting the customers' accounts.

Q. How frequently are customers' accounts balanced? A. Customers accounts are balanced monthly. In order to maintain an accurate control of accounts receivable, all customers' accounts are balanced on a cycle basis, monthly. That has to do with my previous explanation of the fact that these billing operations are continuous, and there are roughly 20 or 25 billing districts, and you have got to establish a point of beginning and ending for the month, by

just an arbitrary basis, but the cycle is exact and repeated.

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To facilitate this balancing, each territory served is broken down into these districts, which in turn are subdivided into what we call controls. The purpose of the balancing operation is to verify the correctness of all entries, including charges, payments, transfers, adjustments and corrections made during the month. This is one of the most important operations of the bookkeeping group.

The ledger cards, which record the customer's account, 6764 are filed in district and address order, and contain meter and rate data for individual customers, and show the customer's name, date of contract, readings in kilowatt hours used, charges and credits. Collection information is also recorded on these cards. That is, they make notes on the cards as to a man's credit rating.

Q. Is the work of the division that you have just described coordinated with the work of the other departments of the Union Electric Group? A. Well, they do have to cooperate very closely with the other departments. The credit, adjustment and collection division uses current customer ledger 6765 accounts extensively in determining the credit of customers. These ledger cards are filed near this group, and are available at all times.

Records of customers' use at former addresses, and of uncollectible accounts, are also readily available.

Adjustment and collection operations are likewise facili-

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tated, as a complete record of the customer is obtainable, resulting in selective collection action and speedy and efficient answers to customers' inquiries and complaints.

The sales department currently prepares analyses of consumption by rates and classes of service in connection with continuing rate studies, and the close coordination of the billing and customers' accounting group assists materially with this work. The nature of the operations of the meter department, electrical distribution department, and cashier's division of the treasurer's department, also requires the close coordination of the billing and customers' accounting group.

Q. Is the unit cost of these operations kept at a low level?
6767 A. Yes, the cost is kept at a very low level. They have 156 employees required to execute the addressograph work on customers' accounts, record customers' orders, render bills, and maintain records on customers' accounts. The cost of this work for the year 1939 was $.7571, slightly over 75 cents per customer, for the total operation.

Q. That is on an annual basis, is it not? A. Yes, and the figure that I read was for the year 1939.

Q. Now explain, if you will, how applications for service are handled in the Union Electric Group? A. We make every effort to make an application for service the simplest possible

6768 —2,879—

operation. That has not always been the case, because I can recall years ago, when I first went to work for the company, that it was quite an operation to get service, a rather formal matter. You had to make an application and fill out a contract; either a salesman had to go and call on you, or you had to go and hunt up the office somewhere; and frequently a meter had to be set.

All in all, it was one of the things that you had to anticipate some time in advance if you wanted to move.

Today, the meter is usually left in place, and there is very little formality. The customer can get electric service by throwing in a switch, when he goes into the house, and make what little arrangements have to be made later.

The service orders are immediately executed upon application, for the convenience of the customers. Application may be made in person at the Union Electric's main office, or at any of its branches, or subsidiary company offices, or may be made by telephone or by letter.

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In most of the territory served, residential and commercial customers, moving in to previously occupied premises, may start service at once by throwing in their own switch, and accommodating us by mailing in what we call a meter tag. There is a tag left on the meter and the customer can take that, and close in the switch and send the tag in, and he fills out the application which is attached to this tag.

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The usual application for residential service is simply in a form requiring only the customer's name, address, occupation, and location of employment, and the location at which service was formerly used, if any. 6771

Commercial applicants execute a service agreement which is also relatively simple in form. The whole effort is to make the operation simple and convenient, and to have a lack of red tape.

The way the thing works is surprisingly well. Some of these methods were adopted with some thought that they might cause considerable difficulty, but nothing of any consequence ever arises. The company wouldn't think of going back to more elaborate requirements for these contracts.

Q. What is the general nature of the group's credit policy? A. Very, very liberal credit policy is followed. As a matter of fact, our credit deposits are not at all extensive. An average of about 9,000 applications for service is received every month, the majority of which are successor connections, due to a customer moving from one address to another. All customers who have a good or fair paying record at a previous address are granted credit immediately, as are new customers whose credit indications are satisfactory.

6773 Surety deposits are required only of previously poor-paying customers, or new customers where there is some reason

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to consider them to be of doubtful rating.

The amount of deposit, when required, is usually the equivalent of bills for two months' service. It is the general practice to refund surety deposits, with interest, after a customer has established a fair paying record over a period of 12 months. We try not to retain any more surety deposits than are absolutely necessary. Surety deposits on hand at the end of 1939 numbered approximately 19,600, amounting
6774 to a total of $138,850, or an average of about $7 per deposit, for all classes of customers.

Residential customers' deposits ordinarily do not exceed, at the most, $5 each. The ratio of the number of surety deposits on hand to the total number of customers served, is about 5 per cent.

The company will also accept guarantors in lieu of surety deposits, in case customers are not able to otherwise establish a credit, a satisfactory credit.

In addition to the surety deposit policy, customers are also granted liberal installment terms on merchandise pur-

chases, for which a nominal carrying charge is made. In order to encourage the use of electrical appliances, this convenience is extended to purchasers of merchandise from other dealers independent of the Union Electric Group. In other words, we frequently make credit installment arrangements through small dealers so that they can extend credit to their customers for the purchase of electric appliances.

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That will be discussed later in more detail.

Q. Are discounts provided for prompt payment of bills? 6776
A. Yes, there is a discount on the residential bill—well, on all bills—of 5 per cent. on the first $25 of the monthly bill, and 1 per cent. on all over $25, if payment is made within 10 days after the date of billing.

Some of the rate schedules provide for a straight discount of 5 per cent. for prompt payment. Certain power and municipal contracts are executed on a net basis, and do not provide for such discount.

Forfeited discounts, where the customer does not pay within the scheduled period, are frequently allowed on bills
paid from one to several days after the last discount date, 6777
provided the customer has a good past paying record, or has a valid excuse.

For example, in the summer time, people take vacations who are otherwise prompt to pay, and when they come in we make an allowance for that, and they don't lose their discount.

Q. Who handles the collection of customers' accounts, and the adjustment of customers' service inquiries? A. Well, that is the principal function of the credit and collection

division. Their job, in addition to passing upon the credit of applicants for service, is to collect past due accounts, and to handle customers' service inquiries and adjustments. We

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keep constantly in mind, in carrying out all of these functions, to maintain good public relations by following a liberal collection policy, and by giving delinquent accounts selective attention.

In general, collection treatment is accorded only to ac-
3779 counts which are two months or more delinquent, if previously good or even fair pay; and one month delinquent if of poor pay reputation, and if in arrears by over $3.

Delinquent accounts to be given collection treatment are selected individually each month by experienced and responsible collection division employees, and the general practice is to grade the accounts for collection effort, beginning five days after the last discount date. That would be 15 days after the date of billing, the discount period being 10 days—and classify them into about three divisions: customers with good or fair past paying records are in the first division,
3780 and for those they send a little notice calling attention to the fact that they probably forgot to pay their bill, but nothing is said about collection or cut-off.

Now on the second class, new customers with unknown credit, this little reminder notice is usually followed up within about 5 days by a mail or collector cut-off notice, and after another 5 days the collector will call.

Customers in this class are given every opportunity to pay or make satisfactory arrangements, without actually cutting off the service.

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In the third class, customers which are frequently delinquent, or what are known as habitually poor pay—two mail notices, spaced 5 days apart, are followed up by collectors or cut-off men, after another 5 days.

In other words, they don't just treat everybody alike, but they take into account the customer's previous record, and our actual experience with his habit of paying his bills.

Disconnection of service for non-payment of bills is made only as a last resort, and even then it is frequently deferred to avoid distress, or inconvenience to the customer in case 6782
of illness or for other just cause. If there are any doubts, they are resolved in favor of the customer. This is evidenced by the fact that in the three largest divisions of the system, comprising over 300,000 customers, cut-offs averaged less than one-half of one per cent. during 1939. Reconnections, after having been cut off, during the same period and for the same divisions, average approximately 80 per cent. of the number disconnected.

Charges ranging from 75 cents in the metropolitan area, to $1.50 in the rural territory, are made to customers for reconnecting the service. 6783

Irregularities and current theft cases are given individual treatment by trained investigators and adjusters. The number of such cases in relatively small in proportion to the

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total number of accounts with which the collection department deals.

Employees of the credit and collection division assigned to the handling of customers' complaints and adjustments, are carefully selected, and are given preliminary training for

that work, as well as close supervision in the performance of their duties.

The policy of the Union Electric Group toward high bill complaints is liberal, and each case is considered as an opportunity to improve customer relations. In other words, a customer coming in and complaining about a high bill may have a just complaint, and there may be something wrong. Frequently there is not. In any event, he is a customer who, if he goes away dissatisfied, is a bad thing for the com-
6785 pany. So they give those customers careful attention and go right out and investigate their complaints, and try to run them down and establish the facts, and if there is any doubt about the complaint, they resolve it in favor of the customer until he repeats the thing too often. Most of them don't.

When high bills are found to be excessive, due to losses of energy not preventable by ordinary prudence, an offer is made to share the loss and the customer is advised to rectify the conditions. Once in a while there is a ground or partial ground in a customer's premises, beyond the meter, and the
6786 current is registered through the meter, and goes to earth

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without enough of it to blow a fuse, and the customer may have a very high bill. It sometimes can run up an extremely large bill in one month. We know, of course, that the customer got no use out of that, and that we didn't lose the retail price of the energy, we lost the cost of it, so we make an effort there to adjust it with the customer.

Division supervisors at all Union Electric Group offices are easily accessible, and every effort is made to give prompt attention to each customer who has any form of complaint.

Q. Can you state the extent of customer contacts arising out of the operations of the credit and collection division? A. There are roughly 49,000 cases handled per month, based on the operations for the year 1939, which might be divided into groups as credit applications for service—107,620 per year, or 8,970 per month; delinquent accounts handled—444,610 per year, or an average of 37,050 per month; customer service problems—32,280 per year, or 2,690 per month.

The combined total for the year of all of these cases was
584,510, or 48,710 average per month. 6788

Q. This is 1939? A. That was for the year 1939.

In the handling of these cases, recorded statistics for the larger communities served to indicate that the credit and collection divisions make about 143,000 customer contacts per month, which can be classified into four groups, such as office contacts per year—251,170; mail contacts, including

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collection notices—901,870; collector contacts—298,430; telephone contacts—263,740. Or a total of 1,715,210 per year, or an average of 142,940 per month.

The ratio of approximately 3 customer contacts to each 6789
case handled is an index as to the method of this division. It is felt that much is gained in terms of preserving and improving good public relations by giving each case individual, personalized attention, rather than mechanical treatment. Yet at the same time, it is our effort to accomplish these results with a minimum of expense.

You see, the meter readers and the collection group are the ones that get in contact with the customers, and it is an important part of the company's operations to see that the customers' cases are sincerely and intelligently handled.

The sales department has continuous contact with the customers, but there are not as many of them, and they don't have as many different people to deal with. So that this other division really establishes, I think, more than any other one group, the company's standing with its customers.

Q. Now is this division organized to operate efficiently and at low cost? A. The organization of this group has received probably as much study as any group in the various

6791 group of companies, and the different subdivisions cooperate with each other in a coordinated manner, and they have studied the various possibilities by which costs could be re-

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duced.

I can recall a number of years ago that a study at that time indicated that with the then development of billing machines, and the then cost of labor, it was questionable whether we could really afford to use the billing machinery. Since that time the machinery itself has been improved, salaries have been increased, and our company's business has

6792 multiplied. So that today it is economical to do so, and it is a matter of making continuous studies of that type that keep the total costs reasonable.

They have round table discussions periodically to educate and improve the efficiency of the personnel engaged in this work, and division supervisors are encouraged to exchange ideas on methods in order to promote better results, as well as to reduce costs, whenever commensurable with the continuance of the collection policies, that is, as to giving the customer personal attention. We try to keep the costs as

low as possible, but not without regard to the service rendered.

Q. Now indicate very briefly, if you will, the unit cost per customer of the operations of the credit and collection division? A. The credit and collection division, and its coordinated operations, including the cost of customers' contracts and orders, the pay and expenses of all employees

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engaged in work on customers' applications, contracts, orders, complaints, and inquiries, as well as supplies and ex- 6794
penses incurred in connection therewith, such as transportation, stationery, postage, building service, including light, heat, refrigeration and janitor work—all those costs are allocated to the billing and collection department. There doesn't seem to be complete uniformity in the accounting in all companies in this respect. Some companies do not allocate the value of the floor space and the light, heat and rent, they keep that as a separate item by itself, but in our case that is all included.

These costs, in terms of dollars of gross electric, heating and gas revenues, excluding energy sales to subsidiary com- 6795
panies, have averaged as follows—well, I won't take the time to go into the details of the make-up of this thing, but I am just going to read the total cost per customer. That is 25 cents per customer for the entire operation for the year 1939. It doesn't vary a great deal, it seems to run within a cent of that amount right along.

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The cost of credit investigations and records includes the pay and expenses of employees engaged in investigations of customers' credit, and the keeping of records pertaining there-

to, the cost of handling surety deposits, credit reports from commercial agencies, and supplies and expenses, such as transportation, stationery, postage, and building service. These costs, accumulated for the year 1939, were 7 cents per customer.

Summarizing, those represent credit investigations and records expense.

Now, the collection expenses include the pay and expenses of tellers and cashiers, and collecting agents' fees, collectors
6797 and other employees engaged in collecting customers' bills; the cost of disconnection and reconnection work; and transportation, stationery, postage and other supplies used and incurred in connection therewith. This expense, including those items for the year 1939, was 64 cents per customer. That 64 cents applies to collecting expenses.

The next item is the uncollectible accounts' losses. Uncollectible accounts losses are relatively low, giving evidence to the efficiency with which the methods of the credit and collection division are carried out, even with the liberal policies in effect, and every consideration accorded to the cus-
6798 tomer. The total losses, in terms of revenue per customers were, for the year 1939—24 cents.

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The sum of all these items of expense per customer for the year 1939, which includes customers' contracts and orders, credit investigations and records, collecting expenses, and uncollectible accounts, amounted to $1.20 per customer.

I would like to state this. It is difficult to get any comparison as to whether these figures are really high or low. It is hard to ascertain that, and about the only basis upon which I could relate this would be to obtain some form of

national comparison. It happens that the only such comparison which I have been able to obtain is from a customer's accounting and collecting expense report from the records of the Federal Power Commission for 1938, a report entitled, "Statistics of Electric Utilities." Now, in 1938, our costs per customer happen to be $1.19, instead of $1.20, it varied a penny, and I should explain that there are certain variations in accounting practices. I mentioned it briefly.

Now, in looking over a list of some 26 companies in the United States, with 200,000 customers and over, for the year 6800
1938, as reported in "Statistics of Electric Utilities," by the Federal Power Commission for that year, I find that the Union Electric Company of Missouri was rated sixth with respect to this expense.

Mr. Odell: Before you go into another line of testimony, I have a little difficulty in seeing the relevancy of all this testimony dealing with the operations and work and policies of your credit and collections divi-

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sion, and I would like to have you point that out, if you will. 6801

Mr. Hamilton: Mr. Examiner, I don't intend to spend much time on this. It seems to me apparent that there is more to running an electric business than just generating hours of energy. We are presenting, and have presented in the case of the other groups, a picture of how these companies operate. Now, I wouldn't say hat we have to spend much t ne on this, I don't want to spend much time on it, but this is just te ete the presentation, in any attempt to give a

6802 *Colloquy*

well-rounded picture of the way the company operates, and too, wherever possible, point out comparisons. That is what we have attempted to do.

The Examiner: Well, this seems to me to be just in line with the pictures you have presented of Washington and Cleveland.

Mr. Hamilton: That is correct.

The Examiner: And I don't think it is unreasonably long, Mr. Odell, and I think it is relevant.

6803 Mr. Odell: I wasn't putting it in the form of an objection. I was just asking a point of information.

Mr. Hamilton: I don't intend that it shall be extended at all, I am going to try and keep it within reasonable limits.

Bearing in mind, Mr. Stokes, that we don't want too much detail on this, state very briefly what the

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practices of the Union Electric group are with respect to centralized purchasing?

The Witness: The purchasing department of the
6804 Union Electric Company of Missouri, or what we have been calling the Union Electric group, purchases all material and supplies for the following subsidiaries, in addition to the requirements of the Union Electric Company of Missouri, as an operating company: Union Electric Company of Illinois, Lakeside Light & Power Company, Union Colliery Company, St. Louis & Belleville Electric Railway Company.

There are one or two other associated little companies, which the purchasing department would pur-

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chase for as well, but they are not very active, and this is the chief group that actually uses much material.

The Department also purchases materials and supplies for the St. Louis County Gas Company, which is an affiliated company, and advises with and makes some purchases for the Iowa Union Electric Company and the Mississippi River Power Company, both subsidiaries.

The centralized purchasing is of considerable monetary importance to the group, some of which, for example, have occasion to buy a type of material very seldom, but which material may be used in great quantities by one of the other companies. As an individual buyer, they would not get a good price, and 6806

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centralized purchasing has very beneficial effects for some of the smaller groups.

Q. Does the operation of a centralized purchasing staff make possible a more rigid control of the quality of the articles purchased? A. Yes, it not only provides a closer control of quality than could be obtained by the individual groups, but the individual groups could not afford the specialized staff. For example, the staff of the department includes 7 buyers, two of whom are graduate electrical engineers and another of whom is a graduate mechanical engineer. In addition, they have a full time salesman who handles the sale of surplus materials and scrap; and a traffic clerk with 15 years' experience in transportation prob- 6807

lems, and a statistician whose duties include market studies and the maintaining of price records.

Now, a small company, or one which does a smaller volume of purchasing, and a good example would be the Union Collieries Company, which runs a coal mine, and whose chief business is getting out coal, but who does use electrical equipment—well, their purchases of electrical equipment would be small in volume and they couldn't possibly maintain any of this type of help. So that it is quite an aid to
6809 those companies who get higher quality men than they could possibly afford for themselves.

The control of the quality of the goods is obtained without additional cost, either, because the division of this help,

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scattered through the various groups, with respect to the quantity being purchased, makes the actual cost of purchasing considerably less.

I notice a figure which sticks in my mind as an example, of $535, billed last year to the steam heating division for purchasing work. Now, that is part of the company itself,
6810 but it was just an item that I happened to observe, where the estimated cost of that would be four or five times that amount, minimum.

Now, in the control of the quality of material, we take poles, for example, creosoted pine poles, and they are inspected on a blanket contract by an inspection agency for both Iowa Union Electric Company and Union Electric Company of Illinois. This service would be more expensive if their volumes were not included with that of the Union Electric Company of Missouri.

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In looking into a new source of supply for mine timbers, this same inspection service was made available to the Union Colliery Company through the purchasing department's close contacts on poles. All line tools and safety devices purchased for the group, are routed through one of the operating divisions for inspection and test, thereby providing not only closer control of quality, for the subsidiaries, but also increasing the assurance of safe equipment. A small company wouldn't have facilities to test those things, they would have

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to take them on the assumption that they were all right. That has to do with things like rubber gloves and devices that linemen use.

Q. Are you able to state any other advantages which accrue to the group out of the use of a centralized purchasing agency? A. Yes, there are many such advantages. The purchasing department can frequently be of special service because of its broad contacts and experience in analyzing proposed knowledge of transportation problems, and availability of engineering buyers for follow-up trips to manufacturing 6813
plants to inspect the equipment, and to expedite its shipment. Where the nature of equipment is highly technical, the services of the electrical engineering department are also loaned to the purchasing department for such inspection.

For example, just before leaving here, or rather just before leaving St. Louis for here, I turned over one of my men to the purchasing department to send to the Westinghouse plant to inspect some switch gear that was just ready for shipment, that being of a very technical nature.

studies, but the Sales department has certain contacts with the rate department in the application of the rates.

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Continuing—clerical and home service, and to a certain extent, advertising work.

Mr. Berry is 54 years old, and has been with the company 29 years, 5 of which have been in his present position.

His first job with the company was in 1911, as a salesman.

We have one rather unusual position, that of dealer sales counsellor. Mr. William P. Mackle holds that position. He correlates the merchandising and promotional activities of the company with those of other dealers, and represents the contact between the companies and the group of appliance dealers throughout the city. That work has been very successful.

Mr. Mackle is 43 years of age and has been with the Company for six years.

The work of the sales department is sufficiently important that I should like to describe just the leader in several of the major groups.

Mr. Paul W. McCormick is in charge of the industrial sales division. He is a man 41 year of age and a native of St. Louis, and has been an industrial engineer for the company since 1928.

Mr. Philip V. Brown is in charge of the residential sales work. He supervises the activities of 16 employes, including a group of women who are home lighting advisers. He is 48 years old and has been with the company for 19 years.

Mr. Robert L. Coe is in charge of the merchandising division. He is acting merchandise manager and supervises and

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directs 36 employes of the division in the sale of merchandise at five stores.

In addition, Mr. Coe, with the help of an assistant, **instructs the supervisers of the** other merchandising division. He is 32 years of age, a native of St. Louis, and has been with the company for 11 years.

The rural service division is under Mr. Edgar J. Gildehaus, as acting manager of the rural service division. He is 33 years of age, a native of St. Louis, and has been in his present position for the last three or four years. 7022

Mr. Carter Lewis is in charge of the industrial and commercial lighting division, and is the acting head of the commercial sales division. His specialty is illuminating engineering. He is 42 years old and has lived in St. Louis all his life.

He not only went to Cornell University, but continued his education at Washington University. He has been with the company for 16 years, three of which have been in his present work.

The industrial heating division is under the direction of Taylor S. Carter, industrial heating engineer. He is 59 years old, and has been with the company for 19 years, mostly 7023
engaged in similar work.

Mr. Freund is in charge of the air conditioning division. He is development engineer in the air conditioning work. He

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is 48 years old, has been with the company 19 years, 11 of which have been in the present work of air conditioning.

Mr. Freund has been very successful in promoting air conditioning work, of which St. Louis is justly proud. We do not make the installations, but we coordinate the work, and we do engineering work for customers and act as con-

tact agent between a customer and a contractor, and do everything possible to assist the promotion of air conditioning work.

The isolated plants division, and the heavy power applications are under the direction of Mr. Frederick V. Armistead, development engineer. He is 42 years of age and has been in the service of the company for 11 years, 5 of which have been in his present position.

Mr. Adolph I. Friemel has been engaged on various forms
7025 of rate application for the sales department. He analyzes to see whether the sales department is properly applying the rate to a particular case. He reports to Mr. Michel. He is 59 years old, has lived in St. Louis for 36 years, and has been with the company for 31 years, 12 in his present capacity.

I would like to mention Miss Kate Carroll. Miss Carroll supervises and directs the work of 38 employes in connection with sales contracts and other matters, and has been in the service of the company for 35 years. She is 51 years old and has lived in St. Louis all her life. She is a very responsible part of the sales department.

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The advertising work of that department is carried on by Mr. William K. Holland. He is 38 years old, a native of St. Louis, has lived in that city most of his life, and has worked for the company for seven years.

Mr. E. H. Tenney is in charge of steam power generation. He has been in the service of the company for 35 years, 22 of which are in his present position. He is 59 years old.

Mr. Tenney is one of the most responsible—has one of the most responsible jobs in the technical work in the company, and is at present engaged in carrying on, in addition

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to the operation of the steam power plant department, he has one job at present at the Ashley Street station construction work representing $1,600,000, in addition to which he is a member of a committee of three—I am one of the members, he is one, and Mr. Miltenberger is the third—who are responsible for the design and general installation of the Venice plant which is now under construction.

Mr. Tenney's supervision covers 688 employes who are engaged in both construction and operation in the steam engineering division. He is the chief mechanical engineer 7028
and carries on engineering studies with respect to steam matters.

His assistant is Mr. G. V. Williamson, who is 39 years old, has been with the company 18 years. Mr. Williamson made one of the most rapid rates growth in the company of any young man with whom I have been acquainted. He is a very abie engineer and has very responsible work at the

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present time. He is Mr. Tenney's assistant. He has been in his present position for 15 years, and has been with the company for about 18 years. 7029

Also reporting to Mr. Tenney is the steam engineering and drafting division under the direction of Mr. Carl H. Rulfs. He is 45 years of age, born in St. Louis, and has lived there all his life.

He has been 24 years with the company, all in engineering and drafting work, and he is chief draftsman.

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Mr. J. B. Wheeler, who also reports to Mr. Tenney, is the mechanical superintendent in charge of the Ashley Street

Station. He is 50 years of age, and has been with the company for 24 years.

One of my first jobs with the company was working with Mr. Wheeler, measuring some piling on the Page Avenue substation, and since that time Mr. Wheeler has occupied a number of positions. He is now in responsible charge of the Ashley Street station.

The mechanical superintendent in charge of the steam operations of the Cahokia power plant is Mr. Edward Lux-
7031 emberg. He is in charge of all steam work at the Cahokia station.

He is 63 years of age and has been with the company 32 years in various capacities.

Mr. Lester L. Kraft is the assistant mechanical superintendent, and is going to be—or is in charge of the work at Venice. He is in charge of Venice Plant No. 1, and is probably destined for charge of the new plant.

He is 44 years of age, has been with the company for 23 years.

The superintendent of supply service is Mark B. Covell.
7032 That is another way of stating in charge of all purchasing.

Mr. Covell reports directly to the management. He is 39 years of age, in charge of 43 employes in the purchasing division, and in addition has 75 employes in the building

—2,991—

division and 35 in the garage work, which is also under his supervision.

He has been with the company about 2 years, I should say.

We discussed the purchasing at some length previously. Mr. Covell is in charge of that work.

His assistant is Mr. Roy Goss, who has 43 employees reporting to him. He is 47 years of age and has held his present position for about 5 years. Previously he was a buyer. He has been with the company for 32 years.

Mr. E. H. Lewis is in charge of suburban operations of the Union Electric Company of Missouri, and is vice president of the St. Louis County Gas Company. He has approximately 1,000 employes under his supervision, and is responsible for the engineering, construction, maintenance, operation, service and customer's accounting in the suburban divi- 7034
sion—that is, the St. Louis County division—of the Union Electric Company of Missouri, and is in responsible charge of the operations of the St. Louis County Gas Company.

Mr. Lewis reports to the executive management of the company. He is 51 years of age, and has been in the employ of the company for 25 years.

He is a graduate of the University of Missouri. His first position with the company was cost analysis engineer.

I arranged to get Mr. Lewis his position with the company

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because I had known him at college, and thought he was a 7035
very able man at the time. He made quite a development in the gas company operations out there. I think Mr. Lewis is entitled to great credit for the work he did in pioneering the gas plant, which is a leader of its kind in the country. It is not such a very large plant, but it is very efficient.

The financial officer of the suburban division is Mr. Dudley Sanford, with the title of assistant treasurer. He is 47 years of age, a graduate of Missouri University, a native Missourian. He has been in the employ of the company

for 21 years, and is treasurer of the St. Louis County Gas Company as well.

In addition to his regular duties as assistant treasurer, for the Electric division and treasurer of the Gas Company, he looks after all accident and claim work for the suburban division, and has charge of the St. Louis County stenographic, mailing and filing divisions, and acts as the representative of Mr. Lewis during the absence of Mr. Lewis.

He also has general supervision over the credit and col-
7037 lection work, billing and meter reading for the county. In his specific department there are 29 employees.

The supervisor of the St. Louis County billing division is Mr. William C. Gebelein. Mr. Gebelein is only 47 years old, but he has been with the company for 28 years. He was first employed in 1913 as a clerk. He has charge of all

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billing matters for the county division, both gas and electric accounts.

Mr. Ned Crider is in charge of the distribution engineering for the suburban division. He is 50 years old, a graduate
7038 of Missouri University, a native Missourian, and has been with the company since 1914.

You will note that a very large percentage of the men in responsible charge of company matters are graduates of Missouri University. We have a pretty good percentage of them.

Mr. Albert L. Strother has charge of the construction and operation of both the electric and gas distribution systems in St. Louis County. That is, he is in direct charge of the distribution lines. He is a native Missourian, 48 years old, and also a graduate of Missouri University.

He came with the company as cadet engineer just out of college, and is now superintendent of distribution and has been since 1926.

He has 399 employees under his direction.

Mr. Strother has been with the company for many years, because I have known him for more than 20 years. He used to work for me when he first came with the company.

Mr. Oscar Huffman is general foreman of the meter and installation division. He is 53 years of age, and has been with the company for 33 years, 23 of which have been in his 7040

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present position. He came with the company as a lineman in 1907.

Mr. Henry G. Roeder is one of the older men with the company, who has been in actual outdoor line work for 27 years, 17 of which have been in his present position. He is 59 years of age.

By Mr. Hamilton:

Q. What is his function? A. He is one of three general foremen in charge of all overhead line crews for the suburban division. I mention him primarily because he is one of the men in responsible charge out there who has been in that particular line of work for so many years. That type of work is frequently regarded as more or less floating type of work. The linemen move around considerably. But the linemen for this group of companies are well paid and they are permanent, they don't move around. 7041

Mr. Harry Wolf is one of three general foremen in charge of all the gas main work. He is 53 years of age, has been

with the company for 33 years, 23 of which have been in his present position.

He is superintendent in charge of gas main construction.

Mr. W. L. Jones, Walter L. Jones, is sales manager for the St. Louis County division of the Union Electric Company of Missouri, and the St. Louis County Gas Company. He is a native Missourian, has been in the employ of the company for 20 years, of which 17 years have been in his present position.

7043 —2,995—

He reported to me as manager of the De Soto office at one time. That was one of the cities in the outlying plants division, and then later he was superintendent of the St. Charles division. In his present position as sales manager he directs the activities of 104 employees, and also has connection with the advertising work as well as the sales work.

The superintendent of sub-stations for the St. Louis County division is Mr. James S. Shaw. He has 60 employees under his general direction, and has charge of the maintenance and operation of the County major sub-stations.

7044 The outlying divisions group of the company are now operated under the general direction of the St. Louis County division, but the superintendent of this group of properties is Mr. Herbert M. Patton.

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He reports to Mr. Lewis, who has been previously described. He has complete charge of the operations of the outlying plants group. He is 55 years old and in 1924 he came with the present group of companies and was made sales manager of the outlying plants at that time.

He reported to me then and has since become manager of that group, with which I do not now have any further connection.

There are 170 employes in the group, and a group of division managers for the various divisions such as Franklin County, St. Charles County, Jefferson County, St. Francois County—all of whom report to Mr. Patton. The individual managers of the various properties I believe I will not describe, I will not mention them in detail, although they are all responsible positions and have a good many employes 7046
reporting to them.

The engineering work for the gas company is under the direction of Owen R. Allgeier, who is 50 years old and started with the company in 1916.

He has charge of all engineering matters for the gas company, of the St. Louis County Gas Company, and reports to Mr. Lewis.

The operation of the gas company plant, that is, the plant of the St. Louis County Gas Company, which is located at Shrewsbury, in St. Louis County, is under the direction of Frank C. Meyers. He is 56 years old and has 7047
been with the St. Louis County Gas Company since 1918.

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The operations of the East St. Louis Division, that is, in and around the city of East St. Louis, are very closely tied in with St. Louis operations. As we previously pointed out, the load dispatcher handles the whole system as though it were one. But they do have, in the Union Electric Company of Illinois, separate supervisers. The manager of the East St. Louis and Alton Divisions of Union Electric Com-

pany of Illinois is Mr. George W. Welsh. He is directly in charge of these two divisions, that is, the East St. Louis and Alton Divisions of that company. They operate in and around East St. Louis and up as far north as Alton, about 20 miles north, including Hartford and surrounding territory.

There are no power plants or power generations under his supervision because that district acquires its power from the plants which we have previously described.

7049 To give an idea of Mr. Welsh's responsibilities, the following superintendents report to him: superintendent of electric department (all refers to the East St. Louis group and all to the Union Electric Company of Illinois)— superintendent of electric department; superintendent of automotive equipment; safety engineer; power sales engineer; assistant treasurer; manager of the Alton office; merchandise manager; and claims assistants.

That gives you an idea of the extent of his work.

He is 59 years of age and has been with the company for

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7050 26 years.

His assistant in the East St. Louis and Alton Divisions is Mr. George P. May, who is actively engaged in the operations of the East St. Louis properties as we refer to them. He is 51 years of age, has been with the company 26 years, 5 of which are in his present position.

He again has a superintendent of electrical matters, Mr. H. J. A. Gerard, who is superintendent of electrical department for the Union Electric Company of Illinois.

He is 58 years of age and has been with the company for 26 years, 8 in his present position.

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An electrical engineer with the company is Mr. George E. Sykes, and by the "company" I refer to the Union Electric Company of Illinois. He is 48 years old, has been with the company for 25 years, 13 in his present position.

The assistant treasurer of the Union Electric Company of Illinois is Mr. Thomas W. Gregory. He carries on all the activities that are ordinarily associated with that job, such as the signing of checks and vouchers.

Mr. Gregory is 68 years old, a native of Illinois, and has been with the company for 38 years, 7 of which have 7052
been in his present position.

He has had various positions, most of his life he has been engaged with the railway companies on the East Side, which properties have been disposed of and are no longer connected with the Union Electric Group.

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Mr. Frank L. Rearden is an assistant treasurer. He supervises as well the billing division, credit and collection division in East St. Louis, and the payroll division for both East St. Louis and Alton. That is for the Union Electric
Company of Illinois. 7053

He is 65 years of age and has been 31 years with the company, 10 in his present position.

He, as a rule, signs all the checks and vouchers, and when he is absent, Mr. Gregory does that work.

Q. Very briefly, now, the principal operators and executives connected with the operation of the Keokuk District. A. The Keokuk District properties are operated as a separate unit under the general supervision of the main part of the group, that is to say, the load dispatcher and all other activi-

ties like that, handle them as well as they handle any other parts of the group. But they have their own employees because that is the Mississippi River Power Company up there as well as the Iowa Union Electric Company.

Each of the local business offices in the Keokuk District is complete and has delegated to it sufficient authority so that all ordinary business transactions with the customer may be handled without delay.

Matters of policy are always referred through the vice
7055 president up there to the St. Louis executives.

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There are 239 employes in the division, of which 134 are employed by the Mississipi River Power Company, and 105 by the Iowa Union Electric Company.

Mr. L. E. Dickinson is the vice president in charge of the Mississippi River Power Company and also vice president of the Iowa Union Electric Company, and is in direct charge of all the operations in that vicinity.

He is 60 years of age, has been in the employ of the company for 27 years. His first position was that of system
7056 operator. The chief assistant to Mr. Dickinson is Mr. Paul L. Mercer. He is in general charge of the division in Mr. Dickinson's absence.

He is 41 years of age and has been with the company for 18 years. He first started as hydraulic assistant and has had various positions.

He is a graduate of the State University of Iowa in 1921. He later got his Master's degree in 1922.

The assistant treasurer of that group of companies up there is Mr. Earl F. Doyle.

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He is 46 years old, and has been with the company for 25 years, 15 of which have been in his present position.

He has had varying positions, starting with the job of cashier.

The hydraulic engineer for the Mississippi River Power Company is Mr. Clarence H. Herolfson, He is 51 years of age, and has been with the company for 27 years, 16 of which have been in his present position.

Mr. A. K. Hillemeier is in charge of the electrical engineering for that group, that is, the Mississippi River Power 7058
Company and the Iowa Union Electric Company. He has been with the company for 16 years, 13 in his present position.

He is 42 years of age.

The general superintendent of the Mississippi River Power Company is Mr. Frank J. Venning. He has charge of the power plant itself. He is 59 years of age, and has been with the company for 27 years.

The mechanical superintendent at the Mississippi River Power Company is Fred H. Rennert; he is in charge of operation and maintenance of the water wheels and all mechanical 7059
operations.

He is 56 years of age, has been with the company 23 years, 13 of which have been in his present position.

The local manager of the Keokuk division of the Iowa Union Electric Company is Mr. G. W. Carlson. He is in charge of the operation of the local electrical distribution in

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Keokuk and surrounding territory. He also supervises the gas generation and distribution system at Keokuk for the Keokuk Gas Company.

Local representatives at Hamilton and Warsaw, Illinois, nd Montrose, Iowa, report to him.

He has 41 electric and 13 gas employees reporting to im.

He is 54 years of age, has been with the company for 27 ears, 15 of which have been in his present position.

The Union Colliery Company and the St. Louis & Belleille Electric Railway Company are under the direction of Ir. Edgar F. Stevens. He is vice president of the Union Colliery Company and the St. Louis & Belleville Electric Railway Company.

He is 50 years of age, has lived in Missouri for the past 7 years, has been with the company for 26 years, and has ad his present position for the past 5 years.

There are 702 employees under his supervision. He was rst employed in 1914 as clerk in the Secretary and Treasrer's office. Later he was engaged in valuation work and ecame auditor of the Union Colliery Company in 1917.

Since then he has been fuel agent, and during the year 92 he was general manager of the Union Colliery Comany, and in 1929 was made vice president of both the Union Colliery Company and the St. Louis and Belleville Electric Railway Company. He is in active charge of the operations

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f the Union Colliery Company, which is the coal mining ompany; as well as the railway company, which operates a ery short railway line, and which is mostly engaged in hauling coal.

Mr. Stevens is a very able operator.

The assistant to Mr. Stevens in the Union Colliery Company and in the St. Louis & Belleville Electric Railway Company, is Mr. Harvey T. Hildebrand. He is 43 years of age and has been employed by the company for 16 years.

Mr. Edward Leming is general superintendent in charge of the operation and production at the Kathleen Mine of the Union Colliery Company. He is 50 years of age, has been employed by the company for 25 years, and has had his present position for the past 12 years.

He resides at Dowell, Illinois, at which point the mine 7064
is located.

Mr. Theodore G. Dyer is superintendent of the St. Louis & Belleville Electric Railway Company, and has charge of its operations. He reports to Mr. Stevens.

He is 52 years old, and has been with the company 25 years, and has had his present position for the past 11 years.

He lives in East St. Louis. He has 67 employees under his direction.

The manager of the Union Electric Land & Development Company, and the Lakeside Light and Power Company, 7065
is Mr. Gordon E. Crosby. He makes his headquarters at

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Lakeside, Missouri, which is essentially the location of the Lake of the Ozarks—that is, that is their mailing address—and is right near the Bagnell Dam.

He is 46 years old, and has been with the company 10 years. He handles the land sales and farm rentals for a large amount of excess land which this company, the Union Electric Land & Development Company, holds as a result of the

construction of the Lake of the Ozarks, and the Bagnell Dam.

There are some recreational facilities involved with the Lake of the Ozarks, and Mr. Crosby has charge of those as well as the Holiday House, which is a hotel, and the Casino, a restaurant, and a fleet of excursion boats and other recreational facilities.

He also manages the operation of the Lakeside Light & Power Company, which is a small company doing business
7067 around the lake, and which has been previously described.

Mr. Hamilton: I think this is an adequate stopping point.

The Examiner: All right, we will continue tomorrow morning at 10 o'clock.

(Whereupon, at 4:35 o'clock p. m., a recess was taken until 10 o'clock a. m., Tuesday, October 29, 1940.)

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7068

Before the 7069

Securities and Exchange Commission

Docket No. 59-10

In the Matter

of

The North American Company, *et al.* 7070

Hearing Room 1101,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Tuesday, October 29, 1940.

Met, pursuant to adjournment, at 10 o'clock a.m.

Before: W. W. Swift, *Trial Examiner.* 7071

Appearances:

S. Pearce Browning, Jr., and Charles S. Hamilton, Jr., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for the Respondents.

Ralph C. Binford and Herman Odell, Attorneys for the Securities and Exchange Commission.

7072 *John A. Woodbridge—By Respondents—Direct*

PROCEEDINGS

The Examiner: The hearing will come to order.

Mr. Browning: If the Examiner please, we should like to interrupt Mr. Stokes' testimony to put Mr. Woodbridge on the stand.

The Examiner: All right.

Whereupon, JOHN A. WOODBRIDGE, called as a witness on behalf of the Respondents, having been first duly sworn, was
7073 examined and testified as follows:

Direct Examination by Mr. Browning:

Q. Will you give us your full name, Mr. Woodbridge? A. John A. Woodbridge.

Q. And your residence? A. I reside at 9928 Litzinger Road, St. Louis County, Missouri.

Q. Are you a vice president of the Union Electric Company of Missouri? A. I am.

Q. Now will you tell us briefly about your personal history and experience? A. I was born in the City of New
7074 York in 1903.

My early days were spent in northern Westchester County, where I attended the public schools through the grades and high school, and then graduated from the Phil-

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lips Exeter Academy at Exeter, New Hampshire, in 1920.

From there I went to Amherst College and received a Bachelor of Arts degree in 1924. That fall I attended Columbia University Law School and received an LL.B. from there in 1927.

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In the fall of that year I became associated with the law firm of Sullivan and Cromwell, New York City, and was admitted to the New York Bar in April, 1929.

While I was at Sullivan and Cromwell, a large portion of my work from the very beginning was in connection with the affairs of the North American Company and its various subsidiaries. A good deal of that was routine, day-to-day work, but a very substantial part was in connection with security issues of the system, as well as security issues of other companies. 7076

One of the early issues I worked on was the bond issue of the Union Electric Company of Missouri in 1932. There were two issues of bonds in that year on which I worked, and another one following in 1933, under the old General Mortgage of the Union Electric Company of Missouri.

I did a great deal of the legal work in connection with the bond and preferred stock issues of the Cleveland Electric Illuminating Company, another subsidiary of the North American Company; with bond issues of the Potomac Electric Power Company, Wisconsin Electric Power Company, 7077

—3,008—

Wisconsin Gas & Electric Company, Wisconsin-Michigan Power Company.

I also worked on bond issues for the Iowa Power & Light Company and the Missouri Power & Light Company.

One of the largest financings, and one of the most difficult that I worked on, was the Union Electric bond and note financing, in 1937, and then there was another issue I worked on in 1938 for the then Electric Company in connection with its preferred stock issue. The last security issue that I

spent a great deal of time on when I was with Sullivan and Cromwell, was the North American financing early in 1939, which involved the issue of $105,000,000 of debentures and preferred stock.

In May of 1939, I went to St. Louis with Dr. William McClellan; Mr. McClellan was former president of the Potomac Electric Power Company here in Washington. Also Mr. Edward T. Gushee, who was at the time vice president of the Detroit Edison Company. The three of us went to
7079 St. Louis as the new executive management of the Union Electric Company of Missouri, Dr. McClellan as president; Mr. Gushee as executive vice president, and myself as general vice president,—and I have been there, performing the duties of that office, since.

Q. You were at Sullivan and Cromwell continuously from 1927 to 1939? A. Yes.

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Oh, I would like to add that I became admitted to the Missouri Bar about a year ago, and just last month formally
7080 enrolled before the Supreme Court of Missouri.

Q. In the course of your financing work, did you have any contact with Commission regulation? A. Yes, practically every security issue that we worked on was under the jurisdiction of one State Commission or another. I believe there was one exception. The Iowa Power & Light Company I don't believe was subject to State jurisdiction. But in all these other cases, we had the problems in connection with the State regulation, in connection with security issues and other transactions that were incident to the particular job.

Q. As part of the duties of your present position, do you have any contact with matters involving State Commission regulation? A. Yes, that is one of the functions of my office, which covers a number of different branches, not particularly clearly defined.

However, the supervision over the regulatory work with both State and Federal Commissions, is under my province.

In addition to that I have supervision over all the legal work of the company, and tax work, and various other things of a corporate nature. 7082

—3,010—

Q. Are the companies in the Union Group subject to State Commission regulation? A. Without exception, as far as electric and gas utilities are concerned, the Missouri companies have been under the supervision of the Missouri Public Service Commission since 1913, and the subsidiary companies operating in Illinois have been under the supervision of the Illinois Commerce Commission or its predecessor commission, since January 1, 1914.

There is one subsidiary, Iowa Union Electric Company, which operates both in Illinois and Iowa, and as to its local 7083 Iowa operations, there is no Commission in Iowa which really serves the purpose of a State Commission. There is a commission there, the Iowa Board of Railroad Commissioners, which has to do with the placing of lines outside of cities and towns. That, however, is more in the nature of location of lines and the use of the highways, but the cities and towns in Iowa regulate the utilities within their jurisdictions as to rates.

I say without exception, because the Iowa Union Electric Company is subject to the Illinois Commerce Commission.

7084 *John A. Woodbridge—By Respondents—Direct*

Q. Do the cities and towns in Iowa also regulate service by the utility? A. They do, to a certain extent. Any questions of dependability of service, the installation of wires and underground conduits—all such matters are regulated by the City Council.

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Q. Can you give us some idea of the staff of the Missouri Public Service Commission? A. The Missouri Public Service Commission consists of five Commissioners, a Secretary, a
7085 Chief Engineer, a Chief Accountant, a Chief Rate Expert, General Counsel, and a substantially large staff of engineers, accountants, auditors, and other employees. The total personnel of the Missouri Commission is about 134.

Q. What is the organization of the Illinois Commerce Commission? A. The Illinois Commerce Commission also has five Commissioners, although the office of one Commissioner is vacant at the present time. They have a Commission Secretary, who has two assistant secretaries; they have a Chief Accountant, Chief Engineer, and a similarly large staff of accountants, engineers, experts, and other employees.
7086 It was organized in its present form around 1914, and, including the Commissioners, I believe its personnel runs around 164 or 165.

Q. Are the companies in the Union Group subject to regulation as to their rates? A. They are. The companies in the Union Group have been in about 65 different rate proceedings before the Commission. The practice on these rate matters in the State of Missouri has never resulted in any litigation over the results of the Commission's findings.

—3,012—

However, the companies have not been ordered to reduce rates a single time in Missouri. Many reductions in rates come purely as a result of informal discussions with the Commission and its staff, or during negotiations during the pendency of a rate proceeding.

It is interesting in this connection to take up, as an example, the case where the company had made a reduction of something over $700,000 a year. The City of St. Louis entered its appearance before the Commission and contended that the company hadn't made a large enough reduction. So 7088
a valuation case started which lasted over quite a number of years.

Finally, in 1937, the Commission completed its case and fixed a valuation or a rate base for the Union Electric Company of Missouri's properties, of $125,000,000.

During the time that the proceeding was going on, the company had made substantial rate reductions in the interim in an amount more than the city had asked for in the first place. So that the case resulted in no order on rates, and didn't take up the question of a fair rate of return.

The city agreed that the company was not earning an 7089
excessive rate of return.

The Examiner: Have you the date on which that proceeding started?

The Witness: I believe I have, sir.

—3,013—

In February, 1928, at the invitation of the Commission, representatives of the Company and of the City started conferences with a view to obtaining lower rates, and as a result of those conferences, the

rates were reduced on May 7, 1928, to the extent of $706,467 per annum, and they were promptly approved by the Commission, effective June 1, 1928.

That actually was the largest single rate reduction up to that time.

The City claimed that there should be an additional reduction of $700,000 a year, and they filed a request in that year that the Commission audit the company's records and require the company to show
7091 cause why a further reduction should not be made.

In July of that year the Commission ordered the accountants to audit the books of the company, and they started in with that audit in August. That audit lasted until September, 1930, when it was completed. While that was in progress, a further reduction of some $16,500 was made.

Between October, 1930, and March, 1931, there were hearings held, and following those hearings, on April 27, 1931, there was a further rate reduction of $375,000 a year. No decision had come down at all
7092 up to that time.

Then in May of 1931, the Commission issued an order directing its engineering department to make an inventory and appraisal of the properties. You see, the previous order had just been an order for an

—3,014—

audit. These cases were all consolidated. The inventory and appraisal commenced in June of 1931, and was prepared in great detail, and was finally filed in March of 1936.

The accountants began new audits to bring their previous ones up to date, and their report was filed in April of 1936.

During that five-year period the appraisal and audits were in progress, the companies involved, that is, the Union Electric Company of Missouri and two small subsidiaries, filed ten revisions in their rates, resulting in rate reductions approximating in the aggregate $1,785,000 a year.

An interesting factor in connection with the hear- 7094
ings on that was that all of the direct testimony of the witnesses on both sides, both for the company and whatever the city wanted to put in, and for the Commission, was reduced to writing before the hearing. I am not sure, but I think that is the first time that that was done in Missouri. At the hearing, counsel were limited to cross-examination of this direct testimony, which, of course, shortened the hearing tremendously. I believe that hearing actually lasted only ten days, and the final result of the Commission's
order was to find the fair value of the properties at 7095
December 31, 1935, to be $125,000,000 for the Union Electric Company of Missouri; $850,000 for the Cupples Station Light, Heat & Power Company; and $32,500 for St. Charles Electric Light & Power Company.

—3,015—

At the same time, the Commission prescribed the depreciation allowance to be set up each year as $2,012,000 on the electric properties, plus 3 per cent. on net additions since April 30, 1935; and $73,000 a

year on the steam properties, plus 2 per cent. on steam additions.

Mr. Browning: Does that answer your question, Mr. Examiner?

The Examiner: I think so. As I summarize what the witness has said, there were some preliminary negotiations and an order for the preliminary examination of the books; then in 1932 an order was entered calling for appraisals; and then the final action

7097 of the Commission was in 1937?

The Witness: That is right.

The Examiner: All right, that answers my question.

Mr. Browning: I would like to have marked for identification as Respondents' Exhibit 56, a table entitled, "Union Electric Company of Missouri—Rate Reductions from 1918 to 1940", which covers two sheets, and to which is attached a third sheet entitled,

7098 "Subsidiaries of Union Electric Company of Missouri—Rate Reductions from 1928 to 1940".

The Examiner: The table will be so marked.

(The document referred to was marked "Respondents' Exhibit No. 56 for identification".)

By Mr. Browning:

Q. Mr. Woodbridge, was this material compiled under your

direction? A. It was.

Q. And was it taken from the books and records of the several companies? A. Yes.

Mr. Browning: I offer it in evidence as Respondents' Exhibit 56.

Mr. Odell: No objection.

The Examiner: Very well, the table is now admitted in evidence under the number assigned.

(Respondents' Exhibit No. 56 was received in evidence.)

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Mr. Browning: I think that the table speaks for itself, Mr. Examiner, so that no particular examination is necessary.

The Witness: I would like to point out in connection with the table that since 1919, there were 51 different voluntary rate reductions on the part of the Missouri companies that aggregated $5,300,000; and that of the subsidiaries in Illinois, the rate reductions since 1928 comprise 31 voluntary reductions, amounting to more than $700,000.

I believe that is the subsidiaries both in Illinois, Missouri, and Iowa. 7101

The Illinois practice on these rates is quite similar to Missouri practice now. Many times there are negotiations with the Commission so that no actual rate proceeding takes place at all. We have had a

few such instances this year.

In Alton and East St. Louis, there were rate reductions in the early part of this year, following conferences with the Commission's staff, and just

the early part of this month there was a further rate reduction in some small territory north of Alton. Hartford, Illinois, was one of the places that has been reduced just within the last month.

y Mr. Browning:

Q. You have testified that Union Electric Company of issouri has never been ordered to reduce its rates? A. That right.

Q. Has any subsidiary of Union Electric Company of issouri been ordered to reduce its rates since it became a rt of the North American system? A. No, there has not en a single case of that. There were one or two cases ior to the time of the companies becoming a part of the stem, but not since.

Q. Have the companies ever had any litigation over the gulatory powers of the Missouri Public Service Commis- on? A. I would say no. There have only been four cases here orders of the Commission have been appealed to the urts, and those involved, in one case the question of a fee yable to the Commission on a bond issue on refunding. e Missouri Commission collects a fee on the issue of bonds, t that doesn't apply to a refunding issue. In that case the

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mmission claimed that since the securities which were re- ided had been issued prior to the Commission coming into stence, that is, prior to 1913, they should collect a fee the refunding issue. I have forgotten the amount of fee olved, but that case was carried to the courts, and the rts decided it in favor of the company.

Of the other cases, one involved the right to acquire stock of another utility; another involved the question of the duty of the company to service a customer suspected of diverting current; and the fourth case involved some question regarding construction of line extensions.

Q. And those four cases are the only cases of litigation in the 27 years since the Missouri Commission started? A. That is correct.

Q. Now as to cases before the Commission itself, could you give us some data on cases before the Missouri Commission in which companies of the Union Group have been involved? A. These cover a very broad range. The total number of cases in which the Union Electric Company of Missouri and its Missouri subsidiaries were involved, have amounted to 232 over this period. 7106

There were 60 rate cases; 3 valuation cases; 5 cases in connection with construction of property alone; 13 cases involving construction of property and approval of franchises; 4 cases involving solely the question of approval of franchises; 26 cases involving the acquisition and sale of

 7107

properties; 10 cases concerning the acquisition of securities; 34 on the issue of securities; 5 on reorganizations; 7 on standards of service; 31 on the question of service to all applicants generally; and 8 miscellaneous.

Included in the 232 cases were 26 cases in which the St. Louis County Gas Company, which is not a subsidiary of the Union Company, was involved. Five of those were rate cases, one a valuation case, three concerning approval of franchises, 13 on issue of securities, 3 on standards of service, and one miscellaneous.

Q. When you say "cases", that refers to proceedings before the Commission, I take it? A. That refers to formal docketed proceedings

Q. It does not indicate any disagreement between the companies and the Commission necessarily? A. Not necessarily.

Q. Now will you give us the same data with regard to Illinois? A. In Illinois there have been a total of 465 cases: 45 on rates; 90 on contracts with other utilities; 1 on valua-
7109 tion; 53 on construction of properties; 12 on the acquisition and sale of properties; 59 on the sale of property alone; 58 on the issue of securities; 1 on reorganizations; 28 on standards of service; 10 on service to all applicants; 31 on aban-

—3,020—

donment of service—that is mostly in connection with railways; 3 on examination of accounts; 8 on financial policies; 10 on contracts with affiliated interests; 8 on records outside of the State; 23 on grade crossings; 10 on crossing protection; and 15 miscellaneous.

Q. Has any company in the Union Group ever appealed
7110 to the court from any order of the Illinois Commerce Commission since it first commenced functioning? A. Not since it became a part of the system.

Q. Do the Missouri and Illinois Commissions exercise jurisdiction and supervision over the accounts and records of the several companies? A. Yes. In Missouri the companies have complied with the accounting regulations of the Missouri Commission for approximately 25 years; and in Illinois, I think for about 21 years.

The Commissions both have Uniform Systems of Accounts now, which, of course, tie in very closely with the

Uniform System prescribed by the Federal Power Commission.

Q. Do the Missouri and Illinois Commissions exercise jurisdiction over the property and franchises of the companies? A. Yes, they do. As was indicated in the data with regard to the type of cases, we have had quite a number of cases in that regard.

In order to start construction of a plant or to enter any

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7112 new section of territory where the companies haven't operated before, we have to get the approval of the Commission.

Q. This is the Missouri Commission you are now speaking of? A. Yes. As a matter of fact, it applies to both Commissions.

For example, there was a case in Missouri where the Union Electric Company of Missouri requested authority to construct a transmission line to a State park. That was about the most recent case in Missouri where we had to get the Commission's approval to extend the transmission line.

7113 In 1929, there was perhaps the largest case in which the Union Electric Company of Missouri was involved on this type of question. That was when they were constructing the Osage hydro-electric project, down at the Lake of the Ozarks, and in that connection the company had to acquire a certificate of convenience and necessity to operate the project and acquire the rights and properties of the company that had commenced the construction.

Q. Is Commission authority required to exercise franchise rights? A. Yes. For some time, even though you get a franchise from a local community in Missouri, that fran-

chise is subject to the approval of the Commission, and you have to get their approval before you can operate.

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A recent case of that kind was where the company requested authority to start construction in the village of Moselle, Missouri. It had already acquired a franchise ordinance from the city, but still we had to go to the Commission before we could commence operations.

7115 Now a utility company in Missouri must submit all copies of new franchises, even though they merely involve renewal of franchises previously obtained.

The Missouri Commission, in connection with these extensions, sets up, of course, the standards of construction, requires that the standards set up by the United States Bureau of Standards and the general orders of the Commission be complied with, so that the public will not be endangered, and there will be no interference with lines of other companies.

Q. You say that the same situation obtains in Illinois?

7116 A. Yes. The most recent case of that happened this year. It was decided that we would build an addition to the generating capacity at the Venice Site on the East side of the Mississippi River over in Illinois.

I had some question myself as to whether or not the approval of the Commission was actually required in that case, because it might have been considered mere addition to an existing plant. However, the plans called for the actual construction of a separated plant on the same piece of property. So we went to the Commission and asked their author-

ity to build that plant, and hearings were held on that, and

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the authority granted.

Q. Now in connection with those hearings, did the Illinois Commission receive testimony regarding the necessity of the plant, the needs for additional capacity? A. Oh, yes. The chief engineer in charge of the power plants, Mr. Tenney, was the principal witness in that case, and testimony in that connection was put in.

Q. Do the companies secure Commission authorization 7118
for the acquisition or sale of property? A. Yes. Before you can sell any property used or useful in public service, you have to get the approval of the Missouri Commission. Usually that would involve the sale by one utility to another, and consequently you would have both companies joining in the application, one to ask approval for the sale, and the other to ask approval for the acquisition. A recent example of that was in 1937. The Mississippi River Power Company, which owns the hydro-electric dam up in the Mississippi River near Keokuk, had a subsidiary, the Missouri
Transmission Company, which owned the transmission lines 7119
in Missouri, which connected the operations up there with operations in Missouri. We wished to eliminate that situation, and in order to transfer the assets of the subsidiary to the Mississippi River Power Company, both companies had to apply to the Missouri Commission for approval. This not only applies to physical properties, but in order

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to acquire securities of another public utility company, the approval of the Commission must be obtained.

Also, in 1937, the Union Electric Company of Missouri was acquiring additional stock—not additional stock but stock of the Keokuk Electric Company, which was a subsidiary prior to that time, and that case had to go before the Missouri Commission for authority.

Commission approval is also necessary in case of a company other than a public utility acquiring 10 per cent. or more of the stock of a public utility. Whenever the Union Electric Company in the past has issued and sold common
7121 stock, or our affiliated company, the St. Louis County Gas Company, has issued and sold common stock to the North American Company, the North American Company has had to apply to the Missouri Commission to obtain approval for the acquisition.

The most recent case of that was in May of this year, when the St. Louis County Gas Company sought approval to issue $1,100,000 of additional common stock which was to be bought by the North American Company. Informal conversations were had with the Commission before application was filed, and that was approved, as well as the appli-
7122 cation of the North American Company to acquire the additional stock. That case, of course, was also subject to the jurisdiction of the Securities and Exchange Commission.

Q. What is the situation in Illinois? A. Illinois has

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very extensive jurisdiction over the acquisition and sale of property. It goes into more detail, even, than the Missouri Commission.

For example, in 1939, last year, the St. Louis & Belleville Electric Railway Company, a subsidiary, had to go to

the Illinois Commission for authority to purchase some equipment from the Union Electric Company of Illinois. That equipment, as I recall, consisted of some rotary converters which had previously been leased to the St. Louis & Belleville Railway Company, which are used in the operation of its electric freight railway line, and Commission approval had to be obtained by both parties on that transaction.

I mentioned before the acquisition by the Union Company of the Keokuk Electric stock going before the Missouri
Commission. The approval of the Illinois Commission was 7124
also necessary on that case, because the Keokuk Electric Company, which was an Illinois corporation, was acquiring all of the property and franchises of the Dallas City Light Company, which was an Illinois company, and Fort Madison Electric Company, which was an Iowa company, and all the details of that transaction had to go before the Illinois Commission.

The Commission has jurisdiction over the assignment, lease, mortgage, sale or encumbrance to public utility properties.

Again, the St. Louis & Belleville Electric Railway Com- 7125
pany merely desired to sell a small piece of property early this year, and it had to go to the Commission for approval

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to do that.

Q. May the companies issue securities without the approval of the Missouri or Illinois Commissions? A. They can issue short-term notes. The requirement in Missouri is one year or less, and I think it is the same in Illinois. But for anything else, stocks, bonds or other evidences of indebted-

ness, the companies have to go to the Commissions for authority, and have done so on quite a number of occasions.

In Missouri, from time to time, when the company has not had an issue for some time, or when the Commission basis for securities has been on a refunding matter, the companies have made the practice of filing an application with the Commission setting forth all their expenditures for the last five years, so that those expenditures will be before the Commission and won't be lost to the company in case they
7127 should wish to come along later and ask for specific approval of securities.

Q. The Missouri companies are permitted to issue securities only against property additions or to refund securities previously outstanding? A. In substance that is correct. Those issues can be either prospective or based on past transactions. If you are asking authority to issue securities for the purpose of acquisition of properties, then, of course, you have to go into considerable detail and support the applica-

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tion with a description of the properties you are going to
7128 acquire or construct. You just can't issue securities for the acquisition or construction of unnamed properties. When the properties have already been constructed, then you can issue securities to reimburse the treasury for those expenditures.

The same thing is true of refunding.

Q. Does the Commission exercise authority over the creation of liens on property? A. Yes, it does. No lien can be created on the properties without the consent of the Commission. I shouldn't say "no lien", as that is probably too broad,

because, of course, you can have mechanic's liens and things like that, which are more or less involuntary.

Q. Or if you don't pay your taxes? A. Or if you don't pay your taxes, yes. We try to pay our taxes unless they are too exorbitant.

In 1937, for example, the Union Electric Company of Missouri obtained the Missouri Commission's approval for the creation of its present mortgage, the mortgage of July 1, 1937, under which the first mortgage and collateral trust bonds are now outstanding. 7130

The only case previous to that, I think, in Missouri, was in 1924, when the general mortgage was issued, and that served as the financing vehicle from 1924 up to 1937.

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Q. Does the Missouri Commission exercise jurisdiction over reorganization plans? A. Yes. There have been two reorganizations of the Union Electric Company itself which have been before the Commission, one in 1917 and one in 1922, and the latter one involved the filing of four separate applications, and the entire transaction was subject to the 7131
approval of the Commission.

Q. Turning now to the Illinois Commission, does it exercise authority over the issuance of securities? A. It does, except, as I said before, for the short-term notes, with a maturity of not more than 12 months.

The largest issue which has been involved before the Illinois Commission was in May of 1937, where authority was requested for the issue of $22,000,000 of 3¾ per cent. bonds of the Union Electric Company of Illinois.

This Commission also has jurisdiction over the creation of liens, and in connection with that bond issue which I just mentioned, specific approval to the creation of the mortgage and the creation of the lien on the properties was also required.

Q. Does the Commission exercise jurisdiction over mergers of public utilities? A. Yes. The $22,000,000 issue was made by the surviving company in a merger which took place at that time. The company was the old East St. Louis Light
7133 & Power Company, which survived the merger as Union Elec-

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tric Company of Illinois, and all the details of that merger were approved by the Illinois Commerce Commission.

I might say in that connection that each of the constituent companies, other than the East St. Louis Light & Power Company, in connection with the merger, had to obtain authority from the Illinois Commission to issue additional stock. These companies weren't actually issuing the stock themselves, but it was desired to have an $18,000,000 common capital of the resulting company. That was larger than
7134 mon capital of the resulting company. That was larger than the combined capital of the constituent companies in the merger.

Q. Why was it larger? A. Well, it was just a fact that it was larger. Of course, the constituent companies had fairly substantial surplus. So in order to make up the difference between the aggregate capitalization of the constituent companies and the final capitalization, an amount of surplus was capitalized, but in order to issue stock against that, the constituent companies had to get authority to issue the

stock first, so as to comply with that Commission rule. It is a statutory rule.

Q. Does the Missouri Commission issue orders determining standards of service? A. Yes. The first orders in this connection were issued in 1915, fixing standards of service, regulating meter readings and billings, disconnection of service, and limitations on the amount of deposits that could

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be obtained from customers as surety for their accounts, fixing the interest rate on such deposits. 7136

This order also covered voltage regulation and the operation of electric plants, accuracy of meters, and fixing periods of tests, and the maintenance of facilities to make such tests.

A few years ago, in 1938, the Commission ordered an investigation and hearing on billing practices of all utilities, and detailed statements of billing practices were submitted at that hearing, and as a result the Commission issued an order which required the utilities to show on their bills the necessary information to enable customers to understand how those bills were made up, so that the customer himself could check the bills. The charge for service had to be stated sep- 7137
arately from any other charge, that is, charges for appliances or for sales taxes, and things of that character.

Q. Does the Illinois Commission prescribe rules covering standards of service? A. Yes, they have very detailed rules.

In 1914, general orders were issued covering frequency and voltage regulation, billing requirements, meter and station records, fixing of periods of tests of meters, location of meters, and extension of lines, and various other detailed matters.

Q. Does the Commission have jurisdiction over the aban-
—3,031—
donment and discontinuance of utility service? A. The Commission does. We, of course, in our system have not had occasion to seek authority to abandon any electric or gas facilities. However, a number of applications have been made to the Illinois Commission from time to time for the abandonment of street railway passenger service. The street railway operations were finally totally abandoned in 1935.

7139 Q. Does the Missouri Commission exercise jurisdiction over the depreciation policies of the Missouri companies? A. Yes. As I was describing the valuation case involving the Union Electric Company of Missouri, I mentioned that the Commission in its order prescribed the annual rates of depreciation to be made by the company. They required the company to set aside each year $2,012,000 for depreciation of the electric properties then in existence, plus 3 per cent. on additions after April 30, 1935.

Q. Does the Illinois Commission exercise any jurisdiction over the financial policies of the Illinois companies? A. It
7140 does. They have jurisdiction over dividend payments which might impair capital, and the use of company resources in any business not directly connected with the business of a public utility.

In one case, for instance, the Union Electric Company of Illinois had to get permission from the Illinois Commerce
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Commission to advance moneys to its subsidiary, Union Colliery Company.

Q. The Illinois Commission has jurisdiction over depreciation policies of the Illinois companies? A. Yes, it does.

As a matter of fact, however, they haven't issued any orders with respect to depreciation policies of any of the subsidiaries since becoming part of the system.

Q. Does the Illinois Commission exercise jurisdiction over contracts entered into by the companies with affiliated interests? A. Since about 1933, I think, the jurisdiction of the Illinois Commission has been extended to cover such contracts, and embraces almost every type of contract you could think of between affiliated interests.

For example, in November, 1937, in order to maintain 7142
arrangements between several of the companies covering the transfer between one company and another of stock supplies, and surplus materials, Commission approval had to be obtained.

Q. Do the companies submit annual reports to the Commissions? A. In both cases, both Missouri and Illinois; these are detailed, comprehensive reports. They have been filed with the Missouri Commission since 1914. The first report contained 51 schedules, and has been revised from time to time.

In 1936, it comprised 63 schedules. The form that is now 7143

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in use, which I believe is quite similar to the Federal Power Commission report—it may be almost identical, with perhaps some additional information required—has about 158 schedules. These schedules call for a company history, information concerning the officers, directors and stockholders, and controlled and controlling companies; and a summary of important changes during the year; balance sheet, income and earned surplus statement, showing the make-up and

detail of transactions during the year, of importance; details on taxes; regulatory commission expenses; officers' salaries, and service and management and engineering contracts; details of plant and depreciation reserve accounts; details on revenues and operating expenses, which covers considerable data on contracts for purchase and sale of energy to other public utilities; and construction overhead; also statistics on generating plant, transmission lines, et cetera, and their operation; and detailed analysis of sales, by rate schedules.

In Illinois the reports are equally comprehensive. The first report prescribed was beginning with the year ended June 30, 1914, and contained 56 schedules. That has grown from time to time, and the present form of report contains about 170 schedules.

The type of information called for by that report is substantially similar to that I have outlined in the case of Missouri.

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In Illinois, the companies now make monthly reports, which is largely statistical information, and covers balance sheets and earnings statements, which are broken down by classes of service, and also show details of kilowatt hour sales and output, or the sales by various classes of service.

Q. Do the Missouri and Illinois Commissions have any requirements with regard to maintenance of records in the State? A. Yes, sir. The Missouri Commission requires the companies to maintain an office in the State at which all records and accounts shall be kept, and no records or accounts can be removed except on conditions which the Commission might prescribe.

The same thing is true of Illinois. Of course the general office of the system is in St. Louis, so that all our books and records, all the general books and records, on Missouri properties, are kept there.

The approval of the Illinois Commission was obtained for keeping the books and records of the Illinois companies in St. Louis. It was considered a much more economical thing to have them all in one place, and the Commission approved that.

Q. Do the companies cooperate with the Missouri and Illi- 7148
nois Commissions in the settlement of customers' inquiries? A. Yes, every now and then, instead of a customer coming to us directly with his troubles, he takes them up with the

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Commission, and the Commission will write a letter down to us outlining the subject of the customer's letter. It usually sends along a direct copy of the letter. We investigate the matter promptly and make a full explanation to the Commission, and that is usually the end of it.

Q. To what do those letters principally refer? A. Mostly
to questions of rural and suburban line extensions. There 7149
are other types of problems which come up from the customers, but the majority of them, I would say, would be on that subject. You see, the utility has to have very definite rules in connection with the sharing of the cost of these line extensions, and many times the customer can't quite understand those rules, so he takes it up with the Commission. The rules are filed with the Commission, and practically have the force of law, so that when we explain to the Commission that we have not deviated from their rules, that usually ends the matter.

Q. Both Commissions have rules prohibiting you from discriminating between customers? A. Yes, one of the principal foundations, I think, of State regulation, is to eliminate unfair discrimination.

Q. So that if a particular customer comes in with a particular request, is it merely a question of whether you would be glad to comply with the request if you were free to do so?

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A. No, it certainly is not. There are a number of cases from
7151 time to time where you would like to be able to do something for somebody that comes in, but you just simply can't do it. You have to abide by your filed regulations which have been carefully worked out.

The Examiner: Let us have a short recess.

(Whereupon, a short recess was taken, after which the hearing was resumed.)

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By Mr. Browning:

7152 Q. Mr. Woodbridge, are these annual reports to the Missouri and Illinois Commission, which you have described, open to public inspection? A. Yes, they are. The monthly reports filed with Illinois are generally compiled into reports by the Commission embracing more important utilities in the State and those are given circulation.

The annual reports are on file at the Commission's offices, open for public inspection.

Q. Are members of the Missouri Commission's staff frequently engaged in work in the offices or on the property of

your Missouri companies? A. Very frequently. From 1928, with the exception of the year 1937, we have had accountants or engineers from the Missouri Commission in work at the offices or on the properties. That audit of the books of Union Electric Company of Missouri and two of its subsidiaries which we have previously referred to involved four to eight accountants in the offices and extended from September, 1928, to October, 1930.

The appraisal, beginning in July, '31, and extending to
July, '36, and the second audit, were made by a force of 7154
engineers and accountants which ranged from fourteen to fifty-six individuals.

The amount charged to Union Electric Company by the Commission for the cost of this work, totaled four hundred

sixty-three thousand odd dollars.

In 1938, late in the year, and working right up into April of this year, there were a group of accountants and engineers which ranged from seven to twenty individuals preparing
an appraisal of the properties and audit of the books of the 7155
St. Louis County Gas Company.

That work has cost the Gas Company some $47,000.00.

Q. Have members of the staff of the Illinois Commission gone to your properties or offices? A. Not to the same extent as in Missouri. From November, 1939, until June of this year, there have been two accountants of the Illinois Commerce Commission making audits of the original cost studies of Mississippi River Power Company and Iowa Union Electric Company.

Charges for that work amounted to about $4,000.00 in the case of Mississippi River Power Company and a little over $1,000.00 in the case of the Iowa Union Company.

Q. Could you give us any figures on the cost to the several companies of the regulation by the Missouri and Illinois Commissions? A. That is pretty difficult to arrive at. We have attempted to make an estimate, but it is really little more than an estimate.

In Missouri the current normal work, we figure, amounts
7157 to somewhere between seventeen and eighteen thousand dol-

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lars a year for the Union Electric Company and two small subsidiaries. Most of that, of course, would be Union Electric Company of Missouri.

In the case of Illinois, somewhere between fifty-five hundred and six thousand dollars. The appraisal and audit expenses, of course, amount to much more.

The annual provisions for amortization of appraisal and audit expenses on the Missouri companies, which include the St. Louis County Gas Company, amounts to $106,563.00
7158 a year.

Q. That is your annual amortization of the total cost of the appraisal and audit which was made? A. That is right.

Q. Do you have the figure on what was the total cost of that appraisal and audit? A. Union Electric Company of Missouri—it was $1,121,000 in round figures.

That must have included some previous unamortized expenses in addition to the more recent case.. Cupples Station Company, the total amount was approximately

$6,300.00, a nominal amount on the St. Charles Company and the total on the Gas Company has amounted to a little over $123,700.00.

Mr. Browning: I would like to have marked for identification as Respondents' Exhibit 57, a series of four charts, the first sheet being entitled, "Union Electric Company of Missouri," the second sheet, "Union

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Electric Company of Illinois," the third sheet, "Mis-
sissippi River Power Company," and the fourth sheet, 7160
"Iowa Union Electric Company."

By Mr. Browning:

Q. Were these charts compiled from the books and records of the company under your direction? A. They were.

(The documents referred to were marked for identification as Respondents' Exhibit No. 57.)

Mr. Browning: I offer the charts as Respondents'
Exhibit 57. 7161

The Examiner: All right, the charts are received as one exhibit, Respondents' Exhibit 57.

(The documents referred to were received in evidence as Respondents' Exhibit No. 57.)

(Discussion off the record.)

Mr. Browning: I would like to have marked as Respondents' Exhibit 58 for identification, a table of security issues consisting of nine sheets, the first sheet being headed, "Union Electric Company of Missouri."

(The document referred to was marked for identification as Respondents' Exhibit No. 58.)

By Mr. Browning:

Q. Was this exhibit prepared under your direction from the information taken from the books and records of the company, Mr. Woodbridge? A. Yes.

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Mr. Browning: I offer it in evidence as Respond-
7163 ents' Exhibit 58.

Mr. Odell: No objection.

The Examiner: All right, it is so received under that number.

(The document referred to was received in evidence as Respondents' Exhibit No. 58.)

Mr. Browning: I would like to have marked as Respondents' Exhibit 59 for identification a series of four tables, consisting of four sheets. The first sheet, which is entitled "Union Electric Company of Mis-
7164 souri," shows earnings available for common dividends and investment, and investment requirements. The second sheet shows gross income, interest on funded debt and times interest earned.

The third sheet shows property and plant account at the beginning of the year, operating revenues and property and plant per dollar of revenue.

The fourth sheet shows, for Union Electric Company of Missouri and Subsidiaries, shows property and plant account at beginning of year, operating revenues, property and plant per dollar of revenue.

(The document referred to was marked for identification as Respondents' Exhibit No. 59.)

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By Mr. Browning:

Q. Was this exhibit prepared under your direction, Mr. Woodbridge, and the material contained therein obtained from the books and records of the several companies? A. Yes.

Mr. Browning: I offer it in evidence as Exhibit 59.

The Examiner: Is the information shown on this exhibit and the previous one correct according to the best of your knowledge and information and belief? 7166

The Witness: They are correctly taken from the books according to the best of my knowledge, information and belief.

The Examiner: All right. These four typewritten tabulations just described are admitted as Respondents' Exhibit No. 59.

(The document referred to was received in evidence as Respondents' Exhibit No. 59.) 7167

By Mr. Browning:

Q. Will you turn to Respondents' Exhibit 57, Mr. Woodbridge? What does the first sheet of this exhibit show? A. This is an historical corporate chart which traces progress from the earliest properties making up a part of the Union Electric Company of Missouri properties, down through to the present company.

You will note that the earliest company, as shown by this chart, was the Guernsey & Scudder Electric Light Company,

which was organized in 1885, doing business in the City of St. Louis, Missouri.

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The present company, Union Electric Company of Missouri, was incorporated in November of 1922. We have often referred to this company as Union No. 4 because it was the fourth company in the series which went by the name of Union Electric Company although the others were Union Electric Light & Power Company, and the present company
7169 was formerly named Union Electric Light & Power Company, so we have sometimes referred to it as Union No. 4.

The first Union company which was organized in 1902, was the outgrowth of five companies. On about the fourth column from the left of the chart, including the single Union Electric Company of Missouri as the first column, you will note in the middle of this fourth column, Union Electric Light & Power Company No. 1, organized in 1902, and that was made up of the combination of the five predecessor companies that branch out from that to the right.

The second Union Electric Company resulted from the
7170 taking over of the Missouri-Edison Electric Company, which is a combination of twelve predecessor companies. That will show up in the third column from the left and as a predecessor of the Missouri-Edison Electric Company was this first company I mentioned before, the Guernsey & Scudder Electric Company.

If you look at the chart prior to the organization of Union Electric Company No. 2, there are a great many predecessor companies and also a great many doing business in the City

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of St. Louis from time to time.

Q. Can you tell us why that situation existed? A. That resulted from the early policy of the City of St. Louis. In 1884, they adopted a franchise ordinance No. 12,723—it is quite a famous ordinance to us out there—which was an open offer to any individual, firm or corporation that wanted to come into an electric business.

If they came in and qualified with the provisions of the ordinance and made an application to install their wires and conduits, then they could get a franchise. They had to accept the terms of the ordinance and post a $20,000.00 bond and 7172
agree to pay the City a proportion of their gross receipts each year. That was two and a half per cent. up to 1890 and 5 per cent. thereafter.

Those 5 per cent. payments that Union Electric Company of Missouri now makes the City of St. Louis, are over $600,000.00 a year at the present time.

The Union Company is a successor to thirteen of the franchises granted under this original ordinance, and the remaining franchises have just gone out of existence.

There were a total of twenty-two individual firms and corporations that qualified under that original ordinance. 7173
The rights under that ordinance are not limited as to duration.

Then there came an intervening period where the policy of the City changed somewhat and they passed an ordinance

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which prevented anyone, further, from obtaining a franchise without special approval from the Municipal Assembly, but in 1896 they passed a subsequent ordinance No. 18,680, known as the Keyes Ordinance, which established an under-

ground district in the downtown section of St. Louis and again made an offer for companies to come in and accept the terms of the ordinance and obtain a franchise.

There were eight electric companies that qualified under this ordinance. Union Electric was the successor of six of these franchises and Cupples Station Light, Heat & Power Company, a subsidiary, held a franchise under this ordinance.

However, the terms of this later ordinance provided that
7175 the rights granted thereunder should expire on April 15, 1940, so that our rights, now, practically stem back to the original ordinance adopted in 1884.

At the present time with the expiration of the Keyes Ordinance franchises in 1940, the Union Electric Company of Missouri is the only company that now holds franchises under the original ordinance.

(Discussion off the record.)

By Mr. Browning:

7176 Q. When did the company extend its operations beyond the City of St. Louis? A. That followed the formation of the third Union Electric Company in January, 1917, and

—3,046—

as shown by the chart, again, the third Union Electric Company is the middle of the second column from the left and that acquired the ten companies in the third column.

Many of those, you will notice, operate in counties outside of the City of St. Louis.

Q. At the time of its formation, in 1922, did the present Union Electric Company of Missouri have any subsidiaries?

A. It had two subsidiaries at that time—the Union Colliery Company, which operated a coal mine at Dowell; the National Subway Company of Missouri, which owned an underground conduit system in downtown St. Louis.

That was acquired in 1926. Union Colliery Company had been incorporated in July of 1917 to develop and operate a coal mine which could be used as a source of supply for the operation of the company's steam power plant and give an assurance that it would at all times have such a source of supply. 7178

In 1927, investment in the Union Colliery Company was transferred to Union Electric Company of Illinois. That company now consumes the major portion of the coal produced at the mine. That transfer was approved by the Securities and Exchange Commission and the Illinois Commerce Commission.

Subsequently, the properties of the National Subway Company were taken over and that company was dissolved in 1927.

Q. Then, if I understand you correctly, Union Electric 7179

—3,047—

Company of Missouri has acquired control of all its present subsidiaries except Union Colliery Company since 1922? A. That is right.

Q. Did it also acquire control of other companies after 1922? A. Yes. In 1923, it acquired control of Cupples Station Light, Heat & Power Company, which I have mentioned several times and the St. Charles Electric Light & Power Company, which does a small business out in St. Charles, Missouri. The same year, the Power Operating Company

was organized to operate the plants of Union Electric Light & Power Company of Illinois.

Q. I don't think we need to give any more detail on those acquisitions because they are shown on the charts. A. They are shown on one chart or another. They won't all appear on the Union Electric Company of Missouri chart.

Q. Of the thirty-two subsidiaries which either existed in 1922 or were acquired subsequent to that time, how many exist today? A. There are only twelve of those subsidiaries
7181 which exist today and a number of these are in the process of elimination.

Q. We will go into that a little later. A. I might say, in this connection, that the chart shows a total of eighty-two predecessor companies of the system as today constituted. That, however, doesn't really count all the companies

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that have one time or another been in the system, because there were a number of transportation companies on the east side, which were in and finally were all eliminated somewhere around 1935. Not all of them; some of them.

7182 Q. Well, now, to recapitulate the present corporate situation, how many companies are there in the Union Electric System? A. The thirteen companies in the Union Electric System, in addition to the St. Louis County Gas Company which we consider in the Union Electric Group, but is a direct subsidiary of the North American Company—of these thirteen companies there are seven electric companies—the Union Electric Company of Missouri, Union Electric Company of Illinois, Iowa Union Electric Company, Mississippi River Power Company, Cupples Station Light, Heat & Power

 7183

Company, St. Charles Electric Light & Power Company and Lakeside Light & Power Company.

Of the seven, two companies—St. Charles Company and the Lakeside Company—now have applications before the regulatory authorities for approval of the transfer of their properties to Union Electric Company of Missouri.

The hearings before the Missouri Commission on both of these cases were held just a week ago today and we expect the orders on these cases momentarily and hope the transfers can be made effective as of the end of this month. 7184

On one of those cases there is an application pending before the Securities and Exchange Commission. I believe that all that is necessary in that connection is the receipt of the

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Missouri Public Service Commission order.

The other case, the St. Charles case, was so small that it falls within the exemptions prescribed by this Commission's rules. It is also hoped that the properties of Cupples Station Company can be taken over very shortly.

There is a complicated old agreement there which dates back to 1912, between the Cupples Company and Washington 7185
University, which expires in February of next year.

A great deal of work is being done on that now to try to work out with the University what will be done when that contract expires and as soon as that situation is solved, the Cupples Station Company will be dissolved.

Accordingly, when that is completed, we will have four electric companies instead of seven, one operating in Missouri, which is the Union Electric Company of Missouri; one in Illinois, Union Electric Company of Illinois, one in

Iowa, Iowa Union Electric Company, which also does a small business in Illinois on the east side of the Keokuk Dam; and Mississippi River Power Company which owns and operates the hydro-electric plant and dam up near Keokuk, Iowa.

That leaves six additional companies now in the Union group.

St. Louis and Belleville Electric Railway Company operates a short electric freight line between Belleville and East St. Louis.

This company carries a large portion of coal that is mined

—3,050—

by Union Colliery Company and supplied to Union Electric Company of Illinois for the operation of its steam power plants.

Union Colliery Company, the company I just mentioned, is the coal company which is owned directly by Union Electric Company of Illinois, the chief user of its coal.

Union Electric Land & Development Company, the principal assets of which consist of the large acreage of land surrounding the Lake of the Ozarks, where the Missouri hydro-electric project is situated. This land is being sold off from time to time as we find customers who like to have property down around this lake, which is largely a resort area.

St. Louis and Alton Railway Company, which I don't consider as an operating company at this time—it owns an electric railway line between East St. Louis and Alton which has been leased since 1930 to the Illinois Terminal Railroad System.

We worked out arrangements for the sale of this railway property to Illinois Terminal Railroad Company and the

transaction was approved some time ago by the Interstate Commerce Commission.

The application on that sale is still pending before the Illinois Commerce Commission. We hope to get the order pretty shortly now and as soon as that transaction is wound up, St. Louis and Alton Company will be dissolved.

Then, there are only two other subsidiaries of the Union Electric Company of Missouri—East St. Louis Railway Company and East St. Louis & Suburban Railway Company.

—3,051— 7190

These two companies are entirely inactive and in process of liquidation. They used to be a part of the transportation system on the east side which was finally abandoned in 1935, but, out of those operations, there resulted a certain amount of ordinary accident and damage litigation and a few of those cases are still pending.

Under the Illinois Law, you can't dissolve a company while it has litigation pending and that is the only thing that holds up dissolution of these two companies.

That completes the present system except for the St. Louis County Gas Company, which does the gas business in 7191
St. Louis County and is a direct subsidiary of North American Company.

Q. You have used the term "east side" several times. Will you state for the record what you mean by that? A. There is a territory on the east side of the Mississippi River in Illinois which is so much a part of the metropolitan area of St. Louis—it comprises the City of East St. Louis, and a number of surrounding villages and we very frequently just refer to it as the "east side," the City of St. Louis being the west side.

Q. Has the Union Electric Company of Missouri or any of its three predecessors known as Union Electric Light & Power Company ever defaulted in the payment of any interest on principal on any indebtedness? A. Never.

3,052

Q. What is the dividend record of those companies? A. No dividends were paid prior to 1907. Up to that time, a surplus of practically over a million dollars had been accumulated and since that time dividends have been paid
7193 each year on the common stock and on preferred stock since its issuance.

Q. So that there has never been a default on the preferred stock dividend? A. Not of the Union Electric Company of Missouri.

Q. Can you give us some figures to indicate the growth of the Union Electric System? A. Well, the first Union Electric Company, the number one company, started off with a capitalization of around $6,700,000.00 of stock, and somewhat over a million and a half of bonds.

The present company has $65,500,000.00 of stock and
7194 $95,000,000.00 of bonds and notes.

The operating revenues for the year 1904 amounted to somewhat over $1,500,000.00 and the property and plant account at the beginning of the year was somewhat over $13,500,000.00. At the end of 1939, the operating revenues of the company, I believe, amounted to over $26,600,000.00. It shows an increase, I believe, of something well over 1,700 per cent., and the property and plant account—I believe this is on a consolidated basis—amounted to over $233,000,000.00

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at the beginning of the year 1939.

(Discussion off the record.)

By Mr. Browning:

Q. Will you give us the present capital structure of the Union Electric Company of Missouri? A. On a corporate basis, it has $80,000,000.00 of bonds which amount to 45.1 per cent. of the total; $15,000,000.00 of 3 per cent. five-year notes, amounting to 8.5 per cent. of the total; $13,000,000.00 of preferred stock, 7.3 per cent. of the total; advances on open account from subsidiaries, roughly, $6,800,000.00, amounting 7196
to 3.8 per cent. of the total; common stock of $52,500,000.00, 29.6 per cent.; and surplus as of July 31, 1940, of roughly $10,200,000.00, amounting to 5.7 per cent., making a total of $177,500,000.00 in round figures.

The common stock equity exceeds 35 per cent., and since 1905, at which time the equity was the same, it has been approximately that figure right straight along.

It is interesting to note in this connection that since the organization of the present company in 1922, all of the common stock except 550,760 shares, which was issued in ex-
change for the common stock of the predecessor company, 7197
had been paid in cash by the parent company.

Q. By— A. (Interposing) North American Company. The bonds, after taking into account that 22,000,000 of

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those bonds are really secured by 22,000,000 pledged bonds of Union Electric of Illinois, the bonds of Union Electric Company of Missouri are equal to about 45.7 per cent. of the property account.

Do you want that on a consolidated basis as well?

Q. Yes. This is a consolidated basis for Union Electric Company of Missouri and its subsidiaries? A. And its subsidiaries. It does not include the St. Louis County Gas Company.

The $80,000,000.00 of bonds on a consolidated basis amounted to 39.1 per cent. of the total; $15,000,000.00 of notes to 7.3 per cent.; funded debt of subsidiaries, totaling $19,270,500.00, to 9.4 per cent.; preferred stock of the Union Electric Company of Missouri of $13,600,000.00 amounts to
7199 6.4 per cent. of the total; preferred stock of subsidiaries, $8,234,475.00, 4 per cent.; $52,500,000.00 of common stock amounts to 25.7 per cent.; the consolidated surplus, $16,386,000.00, 8 per cent.; and minority interest in capital and surplus of subsidiaries, $61,768.00, amounting to one-tenth of one per cent., making a total of $204,453,000.00.

The funded debt is equivalent to 48.1 per cent. of the consolidated property, and the equity of the North American Company in the assets of the system is 33.7 per cent. which is just slightly less than the North American Company's equity in the Union Electric Company of Missouri, itself.

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(Discussion off the record.)

By Mr. Browning:

Q. I believe you testified that all securities issued by Union Electric Company of Missouri since April 15, 1943, have been approved by the Missouri Public Service Commission. A. Yes. That means, of course, that all of the securities of the company that are now outstanding have had the approval of that commission.

Q. Have there been any write-ups in the property accounts of the company since the organization of the first Union Electric Company in 1902? A. I am not sure of 1902. There have been none since 1903, the date of the organization of the second Union Electric Company. At that time, there was a reduction in capitalization which more than offset an increase which was made in 1902 on the organization of the first Union Electric Company. Since that time, there have been no write-ups in the property account of the company or
its investments against which any securities were issued nor 7202
in the property accounts of any subsidiaries since becoming part of the North American System.

Q. Turning to Union Electric Company of Illinois, the second sheet of the Respondents' Exhibit 57, shows the predecessors of that company? A. Yes. That shows sixteen predecessor companies. The present Union Electric Company of Illinois is the continuation of the East St. Louis Light &

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Power Company which was incorporated in 1908 under the name of Consumers Light, Heat & Power Company.

This company was doing an electric utility business in 7203
East St. Louis, Illinois, and surrounding territory. In 1910 there was a merger of two other companies with East St. Louis Light & Power Company surviving, and in 1937, in connection with the large Union Electric financing of that year, four other companies were merged into East St. Louis Light & Power Company to form what is now known as Union Electric Company of Illinois.

I think that is pretty clearly shown on the chart.

The present capitalization of the Union Electric Company of Illinois consists of $22,000,000.00 of bonds, amounting to

51.2 per cent. of the total; $18,000,000.00 of common stock, amounting to 41.9 per cent. of the total; capital surplus of $1,577,985.00, amounting to 3.7 per cent., and earned surplus as of July 31, 1940, of $1,378,970.00, amounting to 3.2 per cent., or a total of over $42,900,000.00.

This company has no securities outstanding with the public, and all of its bonds and stock are owned by the Union Electric Company of Missouri and are pledged under the Union Electric Company of Missouri mortgage.

7205 Q. The third sheet in Respondents' Exhibit 57 deals with Mississippi River Power Company; does it not? A. Yes, sir.

—3,057—

Q. It shows the predecessors of that company? A. Yes. I wish I were more thoroughly familiar with the initial history of this company because it is one of the most exciting stories in the utility business. The Keokuk Dam, I believe, was the first hydroelectric project in the country and it was quite a job to harness the waters of the Mississippi River there at that early date.

The company was organized in 1910 and acquired the preliminary development work and construction work of its four

7206 predecessors that had started the construction of the project, which was under an Act of Congress.

The North American Company acquired control of Mississippi River Power Company in October of 1925, and in the next year, the investment was transferred to Union Electric Company of Missouri.

I have previously mentioned the subsidiary of Mississippi River Power Company and Missouri Transmission Company, which was dissolved and the assets taken over in the last few years.

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Q. What is the present capitalization of Mississippi River Power Company? A. This company has $15,753,500.00 of bonds, amounting to 32.4 per cent. of the total; $2,817,000.00 of debentures, amounting to 5.8 per cent.; $8,234,475.00 of preferred stock, 17 per cent.; common stock, $16,000,000.00, 32.9 per cent.; surplus, $5,768,584.00, 11.9 per cent., making a total of over $48,500,000..

—3,058—

The bonds and debentures have been reduced from their original amounts of $20,648,300.00 ~~in~~ the case of the bonds, 7208
and $3,000,000.00 in the case of the debentures, to the figures I have mentioned there, by operation of the sinking fund.

The Union Electric Company of Missouri, owns 99.7 per cent. of the common stock of the Mississippi River Power Company, which makes its equity 44.7 per cent. of the total capitalization.

Q. The bonds, debentures and preferred stock are held by the public? A. Yes.

Q. The fourth sheet of Respondents' Exhibit 57 shows the corporate predecessors of Iowa Union Electric Company? A. It does. 7209

That shows twelve predecessors. The Iowa Union Electric Company was originally Keokuk Electric Company organized in December, 1911.

Shortly after its incorporation, it acquired the properties shown in the last column of the chart. This company did not come into the North American System until 1925, in October, and was originally acquired by North American Company and transferred to Union Electric Company in 1926, through the transfer of the stock ownership of Central Mississippi Valley Electric properties.

That was an intermediate holding company and was dissolved in December, 1937, so that Iowa Union is now a direct

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subsidiary of Union Electric Company of Missouri.

Also, at that time, it acquired the properties of two other subsidiaries—Fort Madison Electric Company and Dallas City Light Company, which were dissolved.

Q. Have you the total number of predecessor companies which were combined to form the system as today constituted?
7211 A. I think I have already mentioned that. About eighty-two companies, exclusive of certain transportation companies that have been in the system and have been out of the system and are not really predecessors of existing companies in the system.

The Iowa Union Electric Company is the only other subsidiary of Union Electric Company of Missouri that has any securities outstanding with the public.

Its capitalization consists of common stock, $999,315, amounting to 52.2 per cent. of the total; $700,000.00 of bonds, 36.5 per cent., and surplus as of July 31, 1940, of
7212 $215,600.00, amounting to 11.3 per cent.

All of the common stock is owned by Union Electric Company of Missouri and the bonds are held by the public.

The property account of this company, on July 31, was $2,254,000.00 and funded debt amounted to approximately 31.1 per cent. of that amount.

I think it might be wise at this time to recapitulate on

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the securities outstanding with the public.

All the bonds, notes and preferred stock of Union Electric Company of Missouri are held by the public. The

$700,000 of bonds of Iowa Union, which I have just mentioned, are outstanding with the public, and the bonds, debentures, preferred stock and a very small minority of the common stock of Mississippi River Power Company are held by the public.

Then, St. Louis County Gas Company, the direct subsidiary of North American, has bonds outstanding with the public, but all of its common stock is owned directly by the North American Company.

Q. So that those four companies, Union Electric Company of Missouri, Iowa Union Electric Company, Mississippi River Power Company, and St. Louis County Gas Company, are the only companies which have any securities outstanding in the hands of the public? A. That is correct. 7214

Q. What is the interest and dividend record of Union Electric Company of Missouri and its subsidiaries since it acquired control of such subsidiaries? A. Since that time there has never been any default in the payment of interest or principal on any funded debt in the hands of the public and dividends on preferred stocks held by the public since that time have been regularly paid. 7215

Q. When due? A. When due.

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Q. What financing staff do you maintain in the Union group? A. We have no financing staff out there. Of course, I have some familiarity with the mechanics of working up security issues from my previous experience, but we have no financing staff really at all.

Q. And you are engaged in handling other matters besides those dealing with finances? A. A very large part of time, practically all my time, yes.

Q. How does the Union group handle its financing problems? A. Well, ever since I have had anything to do with any of these financings and, I am sure, long before that, they have always relied on the staff of the North American Company which takes the place of any attempt on the part of the Union group to maintain its own staff and that is done without charge to the Union group.

Q. Would it involve expense if the Union group installed a financing staff at St. Louis? A. I believe it would amount
7217 to quite a considerable expense. The Union properties comprise a very large group and its financing problems, when we have them, run to considerable magnitude.

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You would have to go out and retain real experts in the field, if they were available, and, therefore, the ability to rely on North American staff really represents a substantial economy.

Q. Would it be preferable for you to maintain a financing staff in the Union group comparable to that of the North American Company? A. I don't believe that it would. As
7218 you will notice from our attempts to get the Union group down into the smallest number of companies possible, our financing problems would not be a day-to-day matter. We would have one large question of financing at one time and another at another time.

If we had to maintain a financial staff out there, there would be long stretches where there would be nothing for them to do.

Q. Can you give us a typical example of the help which North American renders in financing matters to the Union

group? A. The 1937 issue is a very good example of that. That was a financing of some magnitude. The problems to be met at that time were the refunding of the outstanding funded debt which carried interest rates of 5 per cent. for most of it, and the acquisition of additional capital for expansion.

These problems were given considerable attention by the North American staff and a number of different plans were considered.

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At first, the pressing need at that time was an additional generating capacity at the Cahokia Plant and so attention was given to financing Union Electric Company of Illinois. However, the Missouri Company also needed additional funds and there was an opportunity to refund all the funded debt at a reduced interest rate.

A plan was finally arrived at which was developed very largely by the North American staff, was an issue of eighty million of bonds, fifteen million of notes, by the Union Electric Company of Missouri.

Incident to that was the merger of these four companies 7221
on the east side into East St. Louis Light & Powe. Company, which made an aggregation of properties sufficient to support the twenty-two million of bonds issued by the—sold by it to Union Electric Company of Missouri.

The bonds sold carried a 3¾ per cent. interest rate, refunding some $63,750,000.00 of the general mortgage bonds of the Missouri Company, all of which carried a 5 per cent. interest rate, except $11,250,000.00 which had a 4½ per cent. coupon.

The pledge of the Illinois bonds made the security attractive from the point of view of additional collateral and afforded an indirect lien on the assets of the Illinois Company.

The common stock was pledged under the Missouri mortgage as well as the bonds. In addition to the Missouri securities that were refunded at that time, were eight million of preferred stock of Union Electric Light & Power Company

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of Illinois, which was one of the constituents of the 1937
7223 merger; $6,750,000 of bonds of that company and $2,400,000.00 of bonds of East St. Louis Light & Power Company.

If I recall correctly, I think that six million seven of preferred stock was a 6 per cent. stock. The issue produced at least $7,000,000.00 of additional cash for construction purposes; $4,000,000.00 of that was deposited under the Illinois mortgage and $3,000,000.00 under the Missouri mortgage.

Those deposits were subsequently drawn down when the expenditures were made and certified to the trustees.

7224 To give you an idea of the magnitude of this operation, it required several months of the most intensive work to devise a plan to carry it through. It required the preparation of many papers and documents which included over thirty different applications to four different regulatory commissions—Missouri Public Service Commission, Illinois Commerce Commission, Federal Power Commission and the Securities and Exchange Commission.

All of these documents were quite elaborate in their detail. North American staff was engaged on this in the

beginning, working out the plan and the character of the securities. I, myself, having had quite a bit of experience from the legal end on North American financings, went out to St. Louis as counsel. I was out there for six weeks on the ground, working out the details and these various appli-

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cations that had to be made to these various commissions and also the question of registration under the Securities Act.

A great many problems arose in connection with the job; one that I distinctly remember was the question of financial relationship between the parent company which was issuing the bonds and the subsidiary company which sold its bonds to the parent and which pledged them under its mortgage. 7226

The bankers wanted to make the lien in the Missouri mortgage as close a lien as possible on the business and properties of the subsidiary company, wanted to be sure that the subsidiary couldn't create any type of a security which could come ahead of the pledged bonds, but every now and then, and sometimes fairly frequently, there has to be an interchange, and moneys advanced by the parent company to the subsidiary. It was finally worked out by the assistance of the people at North American Company that there should be a leeway there and that the subsidiary should be permitted to have outstanding at any one time up to a million dollars which could just be an open account and not represented by pledged securities. 7227

The staff of North American Company were, as I have outlined, extremely helpful in all these questions and they brought their long experience to bear, which they had gained

over many years in working on securities, both of the Union Electric group and of other companies of the North American system.

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I don't mean to imply that a lot of work wasn't done by the St. Louis people. They had an enormous amount of work to do in compiling statistical information and working up the financial statements and working on the registration statement, but I don't believe they had anyone there that
7229 was really qualified to pass on the type of securities to be issued to the public.

Several members of the North American staff were working night and day throughout this whole period.

At the time that I wasn't in St. Louis, I was working on the job back here, very closely with Mr. Piske, the vice president of the North American Company, who stayed right with the job until we broke up each morning, which was around two, three or four o'clock.

Mr. Piske has a very extraordinary knack of being able to push these things through and keep them moving.

7230 Another member of the North American staff, Mr. Allen Van Wyck, was of tremendous value in connection with the mortgage. Mr. Van Wyck was a student of public utility mortgages for many years, having gained a lot of experience from the legal end while he was associated with Sullivan & Cromwell, and since 1933, he had been with the North American System and acquired a great deal of operating knowledge as well.

The representatives of the bankers and their counsel are very good on devising all kinds of restrictive covenants and

restrictive provisions on stock issues which, on paper, sound

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very good, and offhand, may seem to be in the interest of investors, particularly when you consider the substance of them, but when you consider the detail of the way they might operate, you can arrive at the same result from the point of view of soundness of the investment, without putting in provisions which may, at times, just hamstring the operation of the company.

So, when you get a man like Mr. Van Wyck, who has had 7232
both the legal and the operating experience, he was of tremendous assistance to me as counsel in just pointing out and explaining to the bankers' representatives and their counsel, how a particular provision would not work satisfactorily with regard to the operation of the company.

Usually, the result would be that a provision would be worked out that was equally satisfactory from the investment point of view, but was much more workable from the company's point of view.

I mentioned my six weeks in St. Louis. Actually, there
was over two and a half months spent on that job, since I 7233
started in on it. I was doing the legal work as distinct from the financial.

I wasn't qualified, myself, to make decisions with regard to the character of the securities. That requires real experience in issue after issue, that the North American people, particularly the president of the company Mr. Fogarty had. He has worked with the heads of the investment houses year after year on security issues of the various subsidiaries and

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he follows the types of securities that can be issued and sold under particular circumstances and has always kept very familiar with that situation.

If Union Company had had to rely on its own resources at that time, I think that they would really have had to go out and get some expert people who might have taken the place of the North American staff. I don't mean by that to say that Union Company couldn't have sold its securities, but they had no one and I don't consider that even now we
7235 would be qualified to go out and get the best price obtainable for the type of securities that would serve the company and in the best possible way.

Furthermore, I don't, myself, know of any independent financial experts that would have been available or are available now who would approach the quality of the assistance that the North American Company gives us in such matters and, if they were, they wouldn't bring the same type of approach to these problems that the North American Company people do.

North American has the entire equity in the Union Elec-
7236 tric Company of Missouri and they are a distinctly interested party whenever we have any financing problem, so that they come in, not only with their long experience, but with their financial stake, and I don't believe that there is any expert, any independent expert, or any banking house, however hard it tried to look at these problems from the company point of

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view, that could take the place of the North American people.

Their point of view is completely different. The bankers certainly perform a function. Usually, whether they act as agent for the company in the sale of securities or as direct

underwriters for the purchasing of securities from the company and reselling them to the public, their primary interest is to get a security that they can sell as promptly as possible and eliminate the risk that they take, particularly in the case of an underwriter.

They also perform a function of looking out for the interests of the investors, because, in order to protect their own reputation, they want to sell a good security.

But, I have worked on so many of these things with
bankers' representatives and bankers' counsel, that I am just 7238
positive that they can not bring to bear the company's point of view, and it is that very important thing which the North American Company brings to our aid in connection with the financial problems.

There is another thing along those same lines. The North American system has quite a number of securities to sell from time to time, much more than any particular component of the group.

That, I believe, gives the system, as a whole, a greater bargaining power than the individual company, itself, might
—3,070— 7239
have.

The bankers in their zeal to sell a sound security at a price that will move it right out quickly, they might well be able to—I won't say exactly put it over on the company, but not get as good a price for the company as could be obtained where you have a lot of securities to sell from time to time. If a particular banker is coming up on one issue, they know that they have got to put in their oar on following issues thereafter and that, I think, creates a greater bargaining power on the part of the combined companies.

I think that puts the bankers more on their toes than if they were dealing with the company's isolated transactions.

Mr. Browning: That is all.

Mr. Odell: Does that complete your direct examination?

The Examiner: Off the record.

(Discussion off the record.)

The Examiner: We will recess at this point until

7241 2:30.

(Whereupon, at 12:55 o'clock p. m., the hearing recessed until 2:30 o'clock p. m. the same day.)

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Afternoon Session.

(The hearing was resumed at 2:30 o'clock p. m.)

The Examiner: The hearing will be in order.

Mr. Odell: Mr. Examiner, I am not in a position to cross examine Mr. Woodbridge at this time.

We would like to reserve our right to cross examine Mr. Woodbridge, and will request counsel to recall or make Mr. Woodbridge available for cross examination any time before the evidence with respect to the Union 7244
Electric Company and subsidiaries is completed.

Mr. Browning: That is satisfactory.

The Examiner: Very well, that agreement will be followed.

(Discussion off the record.)

The Examiner: In view of the situation, I take it that you gentlemen would prefer to have Mr. Stokes resume the stand tomorrow morning, would you not?

Mr. Browning: That is correct.

Mr. Odell: That is agreeable to me. 7245

The Examiner: Very well, we will recess until tomorrow morning at 10 o'clock.

(Whereupon, at 2:35 o'clock p. m., a recess was taken until 10 o'clock a. m., Wednesday, October 30, 1940.)

7246 BEFORE THE

Securities and Exchange Commission

Docket No. 59-10

IN THE MATTER

of

7247 THE NORTH AMERICAN COMPANY, *et al.*

Hearing Room 1101,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Wednesday, October 30, 1940.

7248 Met, pursuant to adjournment, at 10 o'clock a.m.

Before: W. W. SWIFT, *Trial Examiner.*

Appearances:

S. PEARCE BROWNING, JR., and CHARLES S. HAMILTON, JR., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for Respondents.

RALPH C. BINFORD and HERMAN ODELL, Attorneys for the Securities and Exchange Commission.

PROCEEDINGS

The Examiner: The hearing will be resumed.

Mr. Hamilton: Will you resume the stand, Mr. Stokes?

Whereupon, STANLEY STOKES resumed the stand and testified further as follows:

Direct Examination by Mr. Hamilton (Continued): 7250

Q. Mr. Stokes, you have previously described to some extent the various divisions and departments in the Union Electric Group, and have referred to the individuals charged with their operation. Can you illustrate the organization of the outlying plants division of the Union Electric Group by reference to a specific community in that division? A. The outlying plants divisions have been previously mentioned, and I shall illustrate the answer to your question by using the Jefferson County division as an example.

That division lies south of St. Louis County and the City of St. Louis, and contains a number of fairly sizeable towns, 7251
among which are Festus and De Soto.

The organization of that division is under a general superintendent of all divisions, who is Mr. H. M. Patton. He was mentioned previously. Under him comes the division manager. In this case he is located at Festus in Jefferson County, Missouri.

The division manager is Mr. D. Orville Collins. Mr. Collins is 37 years old, has been with the company for 14

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years. He was appointed to his present position in 1939 as the result of the death of the previous division manager, Mr. E. T. Manley, who had been in charge of that division for many years.

Mr. Collins has had various positions with the company, starting in as student engineer, until he is now manager of this division.

Under him is the local representative in each of the larger towns. In De Soto, for example, the local representative is
7253 Mr. Henry Spencer Ditch. He is a man 50 years old, who has been with the company since 1922, and had been primarily engaged in line work. He was a Class A lineman before being made local representative.

The organization at De Soto consists of this local representative and two other men, as well as the young lady who handles the office. These three men have to take care of, or do take care of all of the work that arises in the ordinary routine.

If major construction work or serious cases of trouble were to develop, which would be too great for them to handle, they would call on the division manager at Festus, which is
7254 only about 20 miles away, and he would send over the division crews and equipment.

—3,075—

The outlying division functions somewhat independently from the city, in certain respects; that is to say, all operations which will give the customer better service by reason of being handled locally in the division, are carried out that way.

For example, the collections, credits, billing, and all bookkeeping records and operations which require contact with

the customer, and where he would be delayed if those were carried on in the city, such operations are carried on locally, partly at the local office, such as De Soto, and the rest of it at Festus.

I might illustrate. The metering, of course, has to be done locally, the meter slips and the meter-reading routes followed up in the regular book. That is then transferred to Festus, where the rest of the bookkeeping is done, and the summaries are transferred to St. Louis.

The addressograph work for sending out the bills is done 7256
in St. Louis, but as a usual thing, although not always standardized, the bills are delivered from the division office.

Property records and such matters, which do not concern the customer, are handled in the St. Louis accounting division.

De Soto may be used as an example of the effect on the service and rates and the general effect on electric service in the district, as the result of the Union Electric Group ac-

—3,076—

quiring the properties.

The situation at De Soto is in no way particularly differ- 7257
ent from any of the other typical towns in the outlying divisions, and in the interest of brevity I shall use it as an example.

The property at De Soto, prior to April 1, 1917, was served by the Consumers Electric Light & Power Company. I had some participation in the acquisition of this property, and following the acquisition had complete charge of that division for a number of years, including all operations, such as construction, as well as the ordinary operating functions.

This Consumers Electric Light & Power Company was a small, local power company, belonging to a man named Munroe, and his family, who were residents of De Soto.

The family all seemed to be interested in the business, the father acting in the capacity of president and general manager. There were four individuals engaged in the operation, one of whom was Mr. Munroe's son, and who acted as vice president, and in the office force there was another son of Mr. Munroe who was secretary and acted as a clerk.

7259 The owner himself was active in the operation of the business, and he made agreements for service with the various customers, and handled practically the greater part of the business matters.

—3,077—

The office force was located at a bank which was owned and operated by Mr. Munroe as his principal business, and the company's records were kept more or less in conjunction with those of the bank.

At the date of acquisition by the Union Electric Group,
7260 the property in use, serving the city, was carried at about $55,000 on the books of the Consumers Electric Light & Power Company. This was about what an appraisal later showed. The property itself, briefly stated, consisted of a generating plant containing two 90-kilowatt, 60-cycle generators, only one of which could be operated at a time.

They were driven by a 150 horse-power Corliss engine, the distribution system being about typical for the usual small town at that time, and supplied service to the customers, which numbered 327 as of that date.

During the year 1916, approximately 121,000 k. w. h. were sold by the Consumers Electric Light & Power Company. By April, 1917, the end of the first month's operation by Union Electric, there were 362 customers served.

At the time the property was taken over by the Union Electric, only night service was furnished, except for one day a week when service was furnished for several hours to permit the housewives to do their ironing.

Repeated efforts had been made by the citizens of De Soto to obtain continued service, but had met with no success. 7262

—3,078—

The first month's operation at that town was somewhat hectic. The property was in very bad shape, the plant particularly, and we were repairing it, trying to get it up in shape, particularly the engine. It hadn't been overhauled for so long that when we took the piston out, one of the piston rings had been completely eroded by the water in the steam, and had disappeared, one of the sections of the Corliss rings was totally missing, had gone out through the exhaust.

Within a very short time after we took the plant over, 7263
and were trying to operate it, pending better facilities, the generator burned out a coil. I received a call from the local engineer, so-called. I was in Festus at the time, and I grabbed a car and hurried over there, and on the way over I met young Munroe, who was at that time still acting as local manager for us. He was driving out into the country on some kind of a party, and he hadn't been of much help anyway, so I didn't bother him.

I went on in and found out that the generator was in bad order, called for help and supplies from St. Louis, and in the

meantime we took off our coats and went to work. It was about a 24 hours' steady job there trying to get that thing back into service. We had to go to the drygoods store and get some bias tape, such as women use on their dresses, and some shellac, and rewound the coils for temporary service. That machine didn't last but a few hours. We found it was so old that the insulation was so cracked that you could

—3,079—

hardly remove one coil without damaging the next.

7265 There were two other small generators there that hadn't been used for some time, and we rigged those up during the day and night, and belted them up to the engine temporarily, and were able to continue service.

We then went right ahead with plans for the construction of a transmission line from St. Louis County to Jefferson County, a distance of about 36 miles to Festus, and another 15 miles by the route of the line, over to De Soto.

This line was put in service as quickly as possible, and a sub-station built at De Soto, and from there on we had no further difficulties of any consequence.

7266 The rates in effect at De Soto immediately prior to the acquisition of the property were:

First 20 kilowatt hours per month—15 cents per kilowatt hour.

Next 20 kilowatt hours per month—12 cents.

Over 40 kilowatt hours per month—8 cents per kilowatt hour.

Prompt payment discount for payment within ten days—10 per cent.

Minimum monthly bill: residence service—75 cents; all other service—$1.

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The only source of supply which the Consumers Company

—3,080—

had was its little plant which has been described, and the distribution system was all overhead construction of rather early vintage and in no way complied with the usual power company standards, nor was it in accordance with safety code requirements.

In the process later of making an inventory of the property there, I found that the heavy wire was not unusually located at the end of the circuit, with light wire up toward 7268
the plant. In other words, they used whatever they had at the time, and added on.

Subsequent to the acquisition of the property of this Consumers Electric Light & Power Company, many changes were made, two of which were probably the most important.

First, by early 1918, 24-hour service was being rendered as a result of the completion of the transmission line. I am a little ahead of myself there. We began to render 24-hour service before we actually completed the transmission line. The line followed shortly afterward. At the present time the sub-station at De Soto, with a firm capacity of 1,000 k. v. a., 7269
is supplied with the energy required over a 33,000-volt line connected through transformers to our 132,000-volt, double-circuit transmission line. The sub-station at which this voltage is stepped down is located at Festus in Jefferson County, Missouri. This 33,000-volt line also has emergency supply over a double-circuit, similar line, from Rivermines plant,

—3,081—

which has been previously described. Thus De Soto has available adequate facilities for high quality, continuous service.

The second major change which took place after the Union Electric Group acquired the property was a change in the rates. Effective June 1, 1918, a new schedule of rates was installed, under which charges for residential service to customers using from 20 to 50 kilowatt hours per month were reduced from 20 to 45 per cent.; and charges for commercial service of 20 to 50 kilowatt hours per month were reduced in a varying amount, from 23 to 36 per cent.

The customers in De Soto have since benefited from
7271 Union Electric Group policy of making voluntary rate reductions.

The present residence rate schedule in effect is:

First 32 kilowatt hours per month—6 cents.

Next 168 kilowatt hours per month—3 cents.

Over 200 kilowatt hours per month—2 cents.

For prompt payment—discount of 5 per cent. on the first $25 of monthly bill, and 1 per cent. on the excess above $25, the discount date being 10 days from the date of the bill.

Minimum monthly bill—75 cents.

7272 Under these rates, charges for energy have been reduced as indicated in a little group of comparisons which I propose to give you, and the reduction refers to the rate in effect at the time we took over the property, or just prior to that.

—3,082—

For a customer using residential service and taking 20 kilowatt hours per month, the per cent. reduction has amounted to 57.8. For various uses per month, in a similar manner, the per cent. reduction varies from a minimum of 44.4 up to as high as 62.2 per cent.

On the commercial rates, a customer using 20 kilowatt hours per month has obtained a reduction of 47.4 per cent.; and one using 250 kilowatt hours per month, a reduction of 58.4 per cent., with the reduction varying in between those values for intermediate use.

Substantial improvements in the service rendered at De Soto have been important factors in the increase in the electric business in that town, the number of customers having increased from the 362 at April 30, 1917, to 1,413 at September 30, 1940, notwithstanding the fact that the population of De Soto has increased only from 4,721 in 1910 to 5,117 in 1940. This little town is not growing rapidly at all, but the ratio of the increase in electric service to that of the population is striking. 7274

Total kilowatt hour sales for the 12 months ended September 30, 1940, were 1,776,546. This is an increase of 14.7 times the comparable total for the year 1916.

Also during the period, the distribution system has been modernized, and the property in De Soto is in excellent operating condition. —3,083—

That type of improvement in the service rendered to the customer is fairly typical of the various outlying plant properties with which I had connection. 7275

Q. Very briefly, Mr. Stokes, can you characterize the labor relations existing in the Union Electric Group? A. The relations between the companies and their some 4,900 employees, have long been harmonious. By "companies" I mean the Union Electric Group and the associated companies which have been previously mentioned to some extent, such as the Union Colliery Company and the St. Louis County Gas Company, and so on.

7276 *Stanley Stokes—By Respondents—Direct*

The 3,800 employees in the Union Electric Group proper are represented by an association known as the Employees Mutual Benefit Association. Since 1918, there have been contracts with the association and its membership, which now includes practically all of the employees of Union Electric Company of Missouri, the employees of the Cahokia and Venice plants of Union Electric Company of Illinois, the Cupples Station Light, Heat and Power Company, the Lakeside Light and Power Company, the Union Electric
7277 Land and Development Company, the Iowa Union Electric Company, the Mississippi River Power Company, and the St. Louis County Gas Company.

These contracts between the management and the association contain agreements with respect to wages, hours of labor, general working conditions, and pensions.

—3,084—

A general labor committee represents the association's members in all labor matters. Most of the questions brought up through this committee that cannot be settled readily are referred for decision to a board of adjustment, about
7278 which I have previously briefly made some remarks.

Major problems are brought to the attention of the management by the association's board of directors, and solutions are worked out through the medium of special committees appointed by these directors to negotiate with the management.

This Employes' Mutual Benefit Association is now, under the present labor laws, the agency for the employees with which to deal with the management.

But the interesting point about this is that this association carried on very similar work and relations for many years previously.

The complete revision of wage rates and job classifications, which was agreed upon in 1937, is a notable example of the satisfactory solution of a major labor problem. No strike of any kind has even been called by the Employes' Mutual Benefit Association.

In the East St. Louis and Alton divisions of the Union Electric Company of Illinois, there are about 350 employees. Those working in offices and on the inside, as distingushed from outside workers on lines, sub-stations, and so on, have

—3,085— 7280

never professed any union affiliation. However, Union Electric Company of Illinois and its predecessors have had contracts since 1899 with the International Brotherhood of Electrical Workers, a branch of the American Federation of Labor, which contracts covered the wages, hours of labor, and general working conditions of the outside employees belonging to that group.

Labor relations have been most satisfactory as indicated by the fact that in 40 years there have been only 7 days of suspended operation caused by labor differences.

Q. Now this is the East St. Louis and Alton divisions? 7281
A. That is right.

St. Louis & Belleville Electric Railway Company has contracts with affiliates of the American Federation of Labor covering wages, hours, and working conditions of trainmen, car repairmen, and electricians, who comprise more than half of the 65 employees of the company. No time has been lost in more than 10 years due to labor differences.

The Union Colliery Company has a labor contract with the United Mine Workers of America, an affiliate of the

C. I. O., covering all but about 50 of the 650 employees of the company.

At various times, idle periods have been experienced, in common with other coal producers, due to failure to agree

—3,086—

with the union on general conditions, but in more than 10 years the property has been idle only one day due to local differences.

Wages paid by the Union Electric Company of Missouri,
7283 and subsidiaries, and the St. Louis County Gas Company, compare favorably with those prevailing elsewhere in the locality for similar kinds of work.

Vacations with pay are granted to all regular employees except those on the hourly payrolls of St. Louis & Belleville Electric Railway Company, and Union Colliery Company.

For employees paid monthly, the vacation period is one week after 7 months of service, increasing proportionately for longer periods of service, up to one year, at which time the period becomes two weeks, that is, the vacation period.

For employees paid hourly, the period of vacation is one
7284 week for those with more than one year of service, and two weeks after 5 years of service.

The standard work week for non-supervisory employees is 40 hours throughout the property, with a few exceptions, the major one being in the case of the miners of the Union Colliery Company, whose work week is 35 hours. The usual overtime rate is time and a half. That statement has to do with the regular operating employees; that is, where the construction work of a major character is under way, in which

—3,087—

the building trades are involved, most all of their rules now require double time for overtime.

The safety organization in the Union Electric Group is complete, and functions with success. The value of all modern safety devices is recognized, and many are in daily use. Small group safety committees, with representatives from each group, comprising a central safety committee, bring to light hazards requiring correction, and offer suggestions which, in their opinion, will promote safety.

A safety coordinating committee functions to standardize safety practices throughout the properties, and to see that action is taken to correct hazards that have been observed. 7286

Safety work is encouraged in many ways, such as granting of plaques, cups and other trophies to groups having the best safety records. Any employees in the St. Louis district who would benefit by such instruction, are recommended to attend the foremen's safety training course conducted annually by the St. Louis Safety Council.

In 1939,—113 employees received certificates for taking this course.

A safety bonus plan is fostered by Union Colliery Company whereby cash premiums are paid for safe operation. Since the beginning of this bonus plan, about $45,000 has been disbursed to employees. 7287

Q. Are recreational activities sponsored by the Group

for the benefit of the employees? A. Recreational and social activities are promoted at the present time under the direction of the industrial relations department, through various employees' committees.

In the summer, employees have their annual picnic, and a separate picnic is held at the same time for colored employees. They have various athletic facilities provided, and in every respect the greatest consideration is given to the facilities for employees' recreation.

A women's auxiliary, comprised of the wives of employees, is also sponsored and encouraged.

Employees with 20 years or more of continuous service are admitted into a veterans' association. As of January 1,
7289 1940, this association had 444 members. That, I think, is quite a striking tribute to the average length of service of the employees of this company.

A savings and loan association, which operates in the State of Missouri as an institution for investment of employees' funds, and as a lending agency to assist employees in financing their homes, is also sponsored.

I was one of the charter members of that association, and I can say sincerely that I believe it is one of the best institutions that the company has promoted and fostered from
7290 the viewpoint of the benefits that the employees have received. A very large percentage of the employees are making regular

—3,089—

contribution to it, and they have built a large number of homes.

As of December 31, 1939, the assets of the association had accumulated to $3,299,535. There were outstanding at the time 1,046 loans, all of which represent houses which the employees are buying and making payments on through the association. I say "all of which", and I should say all

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but a very few of which. The total of these outstanding loans represents $3,118,635.

Dividends to shareholders during 1939 averaged 6.67 per cent.

It is necessary for the association as of the present time to refuse to take any additional contributions in certain classes of stock unless accompanied by request for loans. By that I mean that they do not desire at the present time to have depositors who are not installment stockholders or
borrowers. There have been times, of course, where the as- 7292
sociation could use funds, because they had a large demand for loans, but the low rate of interest in other possible investments makes the association's rate very attractive and the group is handling the matters of the association in such a way that the employees themselves derive the benefits, and particularly those employees who are saving their money to buy a home.

The American Legion Post was founded several years ago among employees in St. Louis and the surrounding territory. This Post is extended the privilege of having its

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meetings in the main office building, and is given every encouragement in its activities.

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Employees who desire to make small loans may borrow small amounts of money to meet some emergency. This loan can be obtained from the company, and repayment without interest is handled by payroll deduction. That covers a small amount of money that an employee may need temporarily. They do not charge any interest for that.

Pensions are paid to employees under a voluntary, non-contributory plan. These pensions have a maximum of $50 a month, and are paid to employees retired between the ages of 60 and 70 years. Consideration is at the present time being given by the management to the establishment of a more comprehensive insured plan on a contributory basis. The plan has been developed fairly completely and is being examined and analyzed by the employees at the present time, and it is expected to be in effect in the near future.

7295 The group insurance feature is extended to employees, and has no company contribution feature involved in this particular insurance. It is merely an opportunity for employees to obtain various forms of life insurance, frequently term insurance, at rates much below that which they could obtain if they went individually to get the same insurance. In other words, insurance companies recognize Union Electric Group employees as a high preferred risk, because they all have to withstand or undergo a physical examination as a part of their entrance requirements into this Employes' Mutual Benefit Association, in addition to which they have

7296 —3,092--

medical and dental care, as previously mentioned; and the record is such that the insurance companies, when taking the employees as a group, have offered some very attractive rates.

This represents no contribution on the part of the company, but merely an opportunity extended to the employees to acquire insurance at low rates.

The Employes' Mutual Benefit Association has contracts covering a sickness and accident insurance plan in which some 1,600 members participate. Employees in the East St.

Louis and Alton divisions of the Union Electric Company of Illinois and of the Mississippi River Power Company, and Iowa Union Electric Company, also enjoy opportunities for this life insurance protection.

Sick leave is granted to monthly paid employees to the extent of the number of working days in a two weeks' period, without any deductions from salary. An additional allowance is made in particularly meritorious cases. While hourly paid employees receive no wages while absent from work, efforts are made, within the limitations imposed by working 7298
schedules and the provisions of the Wage and Hour Law, to allow them to make up their lost time.

Q. What is the record of continuous service by employees in the group? A. The average period of service for the employees in the Union Electric group is 11 years. More than

—3,093—

two-thirds of the employees have been in service 5 years or longer, and over half of them ten years and over, and more than 10 per cent. for 20 years or longer.

Q. You previously indicated that the Union Electric
Company of Missouri does a steam-heating business. Will 7299
you state why that steam-heating business was developed by Union Electric Company of Missouri? A. It gradually grew into the steam-heating business as the result of supplying electric service to customers who had been running their own steam-heating and electric generating plants in the larger downtown buildings.

It originally began to supply steam service in the decade between 1900 and 1910. To obtain the electric service load of this type of user, it was generally necessary also to

undertake to supply steam for heating or process purposes which the user had previously obtained in connection with his power generation. Initially such service was provided by using the boiler equipment purchased or leased from the concerns who had discontinued the operation of their own generating plants. This was costly and required maintenance and upkeep on a large number of independent isolated plants, and in 1909 several of these isolated plants were connected through underground mains with a steam power
7301 plant at Tenth and St. Charles Street in the City of St. Louis.

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From this start in central station service, the network of underground steam lines grew, until in 1924 it was connected through a large main to the Ashley street power plant which is located down on the river, and has been previously discussed.

Thereafter the major steam requirements were supplied from that point, and in 1931 a second large feeder main was constructed from the Ashley street plant, connecting with
7302 this Tenth Street plant, to provide additional steam capacity and to further improve the reliability of the service.

Q. How extensive is the steam-heating service? A. The steam-heating service as now operated has 414 customers, and the distribution system includes 72,400 feet of mains, together with the necessary regulating, metering and auxiliary equipment, with a total investment of approximately two and one-half million dollars.

The customers have a connected radiation, that is, the number of square feet of radiators connected to the steam

system, amounting to 2,860,000 square feet, and are heating a total volume of 239,000,000 cubic feet. The normal annual sendout from the steam-heating plant in town is in excess of 1,000,000,000, and the peak hourly demand is slightly over 600,600 pounds of steam.

The system covers the downtown section of St. Louis. 60 per cent. of all of the buildings which are immediately adjacent to these steam lines are supplied heat by the Company. All but one major hotel in downtown St. Louis, and

—3,095— 7304

all main department stores, are served.

The department includes 47 employees. The average length of service with the company is 14 years.

The steam business in St. Louis is just incidental and a necessary operation on the part of the Union Electric Company of Missouri. It is a case of having to supply the service or run the possibility of not being able to suitably supply all the requirements of the customer, in which case there is no doubt that we would not be able to obtain all of the electric service which we now supply.

Q. Explain that, if you will? A. If the customer has to 7305
put in his own boiler plant, and if we are not able to supply all of his requirements, it is only one more step for him, if he has to have his investment in boiler plant and the operation expenses of employees and the handling of purchasing of coal,—it is only one more step to install a generator and produce at least part of his power requirements, possibly the greater part of them, during the heating season.

The revenues from these heating customers amount to about $800,000 for steam, and the approximate annual rev-

enue from the same customers is in the neighborhood of $1,000,000 for electricity. So the services are just a direct adjunct of each other.

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The benefits to the customers are better service and better use of their floor space in their own building, which is quite an item, and from the standpoint of the public it eliminates the handling of large quantities of coal by trucks in the streets, and it eliminates a large number of individual plants,
7307 which is a major asset in the reduction of the smoke nuisance in St. Louis, which is quite serious.

The generation of steam at our Ashley Street plant, through some large modern boilers there, equipped with Cottrell plants, will in the future almost entirely eliminate the smoke which would have been made by all of these independent plants.

So that the steam business is just an incidental business in connection with the electric, but it is entirely appropriate to it, that it is a parallel operation.

There are many advantages in this joint operation. The
7308 company has a large force of trained engineers and maintenance men, and they are available not only to the steam-heating department for its own work, but to act as consultants with the customers and help them improve their operations.

As a means of adding economy to the customers' operations, we have spent considerable time and effort in going over his heating problems with him and improving his efficiency. In other words, it is not our purpose to see how much we can make the customers spend for steam heating, but to keep the overall costs of his electric and steam service within

limits so that he is a satisfied customer, and so that we know

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we can retain the business. And in doing that, nobody benefits by a lot of steam that is wasted, and the pounds of steam per season, per cubic foot of volume heated, have been materially reduced as the result of this activity.

Q. Now in what other respects are the electric and the steam properties jointly operated? A. Well, the officers and executives of the electric company, the Union Electric Company of Missouri, function for the steam-heating department 7310
and it does not increase the cost to the company because the same individuals would be required without the steam company. It is not sufficient in volume to cause any actual increase in executive expenses, but it does give the benefit of their advice and assistance.

It maintains an operating organization somewhat independent of the electric operating department, but under the general supervision of the electric company's supervisor. In all other respects, except that, the general organization of the electric company—by that I mean the Union Electric Company of Missouri—functions for both departments and 7311
requirements such as general accounting, billing, purchasing, stores, sales, legal advice, transportation and so on, are all furnished to the steam group.

The underground construction crews of the electric company, including all equipment, are used frequently and extensively in the construction of steam mains and feeder un-

—3,098—

derground work.

We already have those trained crews for putting in conduit lines, and the steam company can get the use of them.

The common facilities of the Ashley Street steam boiler plant are made available. That is the chief benefit of joint operation because, as I have previously explained, the Ashley Street station functions as a steam reserve station for our hydro system, and the minimum power output from the hydro system occurs in the summertime, in the dryest year on record, and at that time the steam-heating requirements are at a minimum. The result is that the two can function with very little overlapping and to make use of practically the
7313 same equipment. There is also an offset between the hour of peak steam-heating demand, which usually occurs early in the morning, trying to get the buildings warmed up, and the maximum demand on the electric system, which occurs at about 11 o'clock in the summertime and after the steam-heating load has completely gone off in the winter, in other words, at about 4:30. So that there is a high degree of diversity between the steam and electric requirements, and it particularly fits in with the summer low-water season in the hydro plants.

The result is that if the steam company were to be
7314 operated separately, they would have to have a separate steam-heating plant which would cost in the neighborhood of $1,200,000. We would have to—and by "we" I mean the Union Electric Company of Missouri—would have to retain

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the Ashley Street station in practically its present size as a steam reserve for hydro operations. The result is that the combined operations of the two functions in the one plant are economical and proper.

Q. Before you leave the joint operations, let me ask you one or two more questions. Do the buildings operated by

the Union Electric Company of Missouri receive steam heat from the steam department? A. They do. They receive it at the cost of production, and not at the retail rates at which steam is ordinarily sold; so they benefit to that extent.

Q. And are office facilities provided by Union Electric Company of Missouri for its steam-heating department? A. They are provided, but the cost to the company for those offices is allocated at cost without any overhead to the steam-heating department. But the net result of this is a material savings to the steam-heating company. They couldn't main- 7316
tain offices such as they have for the price they are paying.

Q. State if you will the approximate amount of savings arising out of the joint operations of the steam and electric businesses? A. As the result of making a fairly detailed estimate of a number of small items which indicate the savings obtained by joint operation, the round figure total for a group of miscellaneous items is $13,000 a year. This particular group of items, briefly mentioned, includes the use

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of the general office building space and facilities, the services
of the general accounting, billing and collections department, 7317
including the credit and adjustment work; purchasing facilities; the handling of material for the steam department by the electric stores group; the machine and utility shops; and miscellaneous services. All of those combined represent an annual saving of about $13,000, somewhat over $13,000, on a conservative estimated basis. This is a saving to the steam group as compared with separate and distinct operation.

Now the saving which I would estimate as the result of the joint operation of the Ashley Street generating station is

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that of the fixed charges on a separate steam-heating plant. The steam cost billed to the steam company from the Ashley Street station is billed at cost, and the equipment and boilers and facilities are such that it could produce steam there as cheap or cheaper than it could anywhere else. If we had to build a separate steam-heating plant it would have to be built in a different location and water supply facilities would not be as good as they are at Ashley Street. So that I am very conservative when I say that the steam department
7319 would have to bear the fixed charges only on the new plant. I doubt if they could produce the steam quite as cheaply there as they now get it. Those fixed charges on $1,200,000 at a very conservative figure of 10 per cent. total per year, to include interest, taxes, depreciation, and such items, would

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amount to $120,000 a year. The actual charge billed against the steam department for what may be regarded as the equipment fixed charges for the Ashley Street plant amount to about $36,000. The actual figure for the past year is $36,112. This results in a saving of $84,000 in round figures.

7320 —3,102—

Now in addition to the two items which I have mentioned, there would be a large number of small miscellaneous items which I have not attempted to detail exactly, but I would say that they would far exceed $3,000 a year, with a total then in combined savings being estimated at $100,000 for the steam group as compared with independent operations.

In addition to that, there is an economy to the electric company itself, these savings here having been those expressed in terms of the economy that the steam group gets.

The electric company has a problem in the operation of the Ashley Street plant that the same crew has to be kept there at all times that is required for regular operation. The boilers and equipment such as are used today operate with automatic equipment, that is the pulverized fuel operation and the automatic heat control equipment, so that about the same operating force is required whether you are carrying a light load or a full load. The result is that if we are carrying the maximum output from the plant, the men themselves do not do anything different than if they were running 7322
on a very light basis. During the period in which the Ashley Street plant is not used for generation, but is carried as a stand-by plant solely for immediate operation on notice, the electric company would have to bear the entire cost of the operating crew and miscellaneous expenses, if it were not for the fact that the steam department can use steam during those periods, and does.

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It is not possible to provide an exact estimate of this saving for the simple reason that it is impossible to say just how much generation an electric company will do in an 7323
average year. If no generation were done for an entire year, these savings would represent possibly $134,000. If, on the other hand, the operation was continued for half a year, it would reduce that amount to about one-half.

Now the method by which I arrived at that figure is this. The present monthly payroll at the Ashley Street plant for operation and maintenance is about $16,400. Under the present basis of apportionment of cost between electric and steam service accounts, the electric generating accounts

absorb about $5,167 per month, including $4,154 for operating labor and $1,013 for maintenance. I just picked these out from the 1939 operations. The excess of $11,233 of monthly payroll expense is to a large extent absorbed by the steam service accounts, when no electric generation is done. That is, in other words, they bill the steam company at actual cost for the steam produced, and if there happens to be a little generation they get most of the charges. At the same time the electric company would have to bear the same expense
7325 in any event.

So that I would say that within the limits of possibly $50,000 a year minimum and $135,000 maximum, that some figure in the neighborhood of $75,000 to $100,000 would be a fairly reasonable estimate.

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Q. Now this represents a saving to the electric business? A. That is right. In other words a combined saving which it appears to me would be a fair estimate as a combined total saving to the group might be taken to be at a maximum of $200,000, and probably not less than $150,000 or $175,000
7326 at any time.

Q. Are there similarities as between the electric and steam-heating business with regard to demands for continuity and character of service? A. Oh, they both have the same general problems. It is a little more difficult to provide continuous electric service than it is continuous steam service, but in general they have similar problems.

They both use the public streets, and they both are regulated alike, and they both involve the selling and delivery of a service, rather than a commodity; and they are both patronized by most of the communities in the area served.

Consequently, where such two utility services are operated jointly, there is an economy in the supplying of the service, and a benefit to the customer. You only have one group to deal with, and only one man is required to read the meters, and in general it is advantageous to all parties to maintain such service.

As a rule, the supply of steam service is not generally regarded as a particularly profitable business. All the advantages and economy from this joint operation are reflected in the rates and quality of service so that the consuming 7328
public is the one who is ultimately benefited thereby.

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Q. In order to get a picture of the trend, if any, in the steam-heating business, will you state a comparison between steam-heating revenues and output and number of customers, between the year 1930 and the year 1939? A. Well, for the year 1930 the heating revenue was $755,596. At that time there were 287 customers who used 887,763 M pounds.

In 1939 the heating revenues were approximately the
same, being $750,510, with steam sold being 870,329 M 7329
pounds. The number of customers at the end of the year 1939 was 390.

You will notice that there was a slight reduction both in revenue and in steam sold, but in general the business has been fairly uniform. The largest year was in 1937 when the revenue went to $828,956, and the steam to 1,004,699 M pounds. The amount of those items is a function of the temperature, it is a matter of how cold a year we have.

Q. Those statistics are exclusive, are they not, of the steam-heating business conducted by the Cupples station

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Light, Heat and Power Company? A. Well, they are, but you wouldn't be able to detect the difference hardly if you added that in. The Cupples Company has 11 steam-heating customers in one block of buildings, and obtains its steam from the steam-heating mains of the steam division of the Union Electric Company of Missouri.

I explained that there was a little generator operated in

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this Cupples block, and I do not recall that I did explain
7331 how that energy, generated by that little generator is sold back to the Union Electric Company of Missouri.

Q. I think you have explained it. A. All right.

Q. Now when was Union Colliery Company organized, and what does it do? A. Union Colliery Company was organized in 1917. It carries on a coal mining business and sells coal to the Union Electric Group and to outside users.

It is a mining company of considerable size, and well regarded in the State. It is located in the State of Illinois, near Duquoin.

7332 Q. Has it been a subsidiary directly or indirectly of Union Electric Company of Missouri, since its organization? A. At the present time it is a subsidiary of the Union Electric Company of Illinois, which in turn is a subsidiary of the Union Electric Company of Missouri. It has, to answer your question generally, been a subsidiary.

Q. Of Union Electric Company of Missouri, since its organization? A. Yes.

Q. Now very briefly state what properties the company owns and operates? A. The company owns and operates this

mine to which I have referred, located near Dowell, Illinois,
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about 85 miles from St. Louis, in a southeasterly direction.

The present operations are in the field generally referred to as the Franklin County field. This coal in this field is of better grade than the coal in and around St. Louis. Coal is removed from what is known as the Illinois seam No. 6, which varies from 7 to 12 feet in thickness, and the quality of coal compares favorably with the best in Illinois, being
low in sulphur and high in heat content for an Illinois coal. 7334
It is entirely satisfactory coal for use in all the company's steam plants.

The company—that is the Union Colliery Company—has under consideration leasing additional tributary coal lands to the west and south of the present mine, of approximately 3,000 acres. It also owns coal rights to 18,000 acres of land containing about 25,000,000 tons of coal, which location is only about 25 miles from the St. Louis switching district.

The property of the mine is wholly mechanized and electrically operated throughout. In fact, the mine is as modern
as any mine in Illinois. It has complete automatic skip 7335
hoists, and the interior of the mine is completely equipped with electric haulage and electric loading is done with mechanical loaders, and in every respect it is a very modern mine.

Underground hauling is done by electric locomotive. As a result of the relation of the Colliery company to the Electric Group, we naturally do the electrical engineering for the
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mine, and I believe that if you were to visit this mine you

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would see some striking differences in method followed, which are somewhat different from those frequently carried on. In other words, they have automatic sub-stations located down in the mine, and feed them at somewhat higher voltage, and in every respect, carry on about the same type of distribution we ourselves use above ground, only taking the special precautions which are necessary in mining work.

The trackage underground is completely equipped with special electric interlocks and means of cutting off one sec-
7337 tion of the track in case trouble exists on the trolley or rail system, which is not customary in most mines.

The daily capacity of the mine is rated at 5,300 tons. Production for the year ended June 1940 was 1,305,000 tons. The property account of the Union Colliery Company as of September 30, 1940, amounted to approximately $2,375,000.

Of this 1,305,000 tons to which I referred as the production for the year June, 1940, 1,260,000 tons was salable, the rest being lost in waste cleaning, that is in washing, and a certain amount of use at the mines.

The sales of this 1,260,000 tons were approximately
7338 divided into 1,010,000 tons to the Union Electric Company of Illinois and the Union Electric Company of Missouri; and 250,000 tons to outside customers not connected with the Union Electric Group. That is, in other words that the sales

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were approximately 80 per cent. to the Union Electric Group and 20 per cent. in the ordinary coal markets.

The average revenue from coal sold to the Union Electric Company of Illinois and the Union Electric Company of Missouri, was $1.706 per ton, and to outside customers—

$2.23 per ton. You see the Union Electric Group take screenings and a little lower grade of coal, whereas the outside customers are regular coal customers for prepared sizes. A good deal of that coal goes to the Chicago district.

There are about 600 men employed, and the mine is the chief source of income for the population around Dowell, Illinois.

Q. Now you have stated the annual output for 12 months ended June 30, 1940, and given for that period the relative
sales to the Union Electric Group and outside. Please give 7340
us comparable information, very briefly, for a preceding period. A. I have available the sale of coal over the last 10-year period, and I will just sketch the tonnage roughly.

For the year 1930 the tons sold were 1,159,314. That varies for reasons which I shall explain shortly. It has reached the lowest, in the year 1933, at the bottom of the depression, and pretty low in 1935. Those years were not only depression years, but they also represented fairly good hydro years. I will go into that in a moment.

By 1939 the sales had again become 1,041,561 tons. For 7341

several years during that period the sales had exceeded 1,000,000 tons.

Q. Now if you will, a very brief indication of the range in gross revenues during the period you have indicated. A. The gross revenues have varied from a minimum of about $813,000 in 1932, and slightly more than that in 1933, to $1,914,000 in 1939.

In general, out of the 10 years, for eight years out of the 10, the revenue has exceeded $1,000,000 a year gross.

Q. Now in percentages, the amount of coal produced, sold within the Union Electric Group, and the amount sold to others. A. I have stated the division for one year as being roughly 80 and 20 per cent. It doesn't vary greatly from that, but I will state the distribution for a five-year period by years.

In 1939—75.4 per cent. was sold to the Union Electric Group, with the remainder of 24.6 per cent. sold outside.

Similarly, in 1938—73 per cent. to the Union Electric
7343 Group; in 1937—69 per cent.; in 1936—71 per cent.; and in 1935—63 per cent. was sold to the Union Electric Group, and principally the Union Electric Company of Illinois and the Union Electric Company of Missouri itself.

The explanation which I wanted to make with regard to the wide fluctuations of the supply of coal and the demand for it, has to do with the correspondingly wide fluctuations in hydro power for the Union Electric Group, and on short notice they call the coal company up and tell them that they

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will not need the anticipated coal next month, or that they
7344 will need twice what they anticipated. This is a difficult situation for a mine to accommodate itself to. It requires that it go out in the open market frequently and buy additional coal to meet our demands, and then again that it reduce its operations rather suddenly and endeavor to find an outside market quickly for shipping the coal. They have been very successful in meeting these requirements, but they would not be readily met by contracts with outside coal mining companies.

Q. Does the Union Electric Group buy all of its coal from the Union Colliery Company? A. No, it buys most of it. As

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I indicated, there are times when the company buys coal in the open market. Usually the Colliery Company purchases the coal for us because they have more experienced men in this particular work.

Q. Now in general, what are the bases for charges for the coal made by Union Colliery Company to the Union Electric Group? A. The basis of the charge for intercompany sales has in the past been such that the price paid by the Union Electric Group would be no greater, or nearly the same, as
could be determined, as that which they could have obtained 7346
from contract with outside suppliers. In other words, in all cases the coal has been sold to the Group in competition with the best responsible contracts which could have been secured with equivalent satisfactory coal. As a result of the passage

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of the Guffey Coal bill, the so-called intercompany sales, or sales to the Group, will be, of course, determined by the prices stipulated in the Guffey bill. So that that is a rather definitely defined basis.

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The reasonableness of charges made prior to the estab- 7347
lishment of the Government prices is indicated by the fact that with the establishment of these minimum fair prices, the effect does not change the prices to the group by more than 2 per cent. on either coal delivered by the colliery company or on coal which they purchase on the outside. That merely demonstrates that the method of pricing has been fair and accurate and corresponds with the prices set when the Guffey Bill went into effect.

The Examiner: Let us take a short recess.

(Whereupon, a short recess is taken, after which the hearing is resumed.)

The Examiner: We will resume.

By Mr. Hamilton:

Q. Now, Mr. Stokes, what advantages are there to the Union Electric group out of the ownership and operation of the Union Colliery Company? A. Well, I have previously
7349 described the wide variation in the requirements for coal brought about by our hydro power, and the fact that we can make that kind of an arrangement with a company which is owned by the group much more satisfactorily than with an outside concern.

In addition to that, the control of our source of coal supply by the ownership of the mine is an insurance against a shortage of coal, and a protection for our customers.

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It is quite an item to be able to control the source of your own supply of a commodity which is the most important
7350 of anything with which we deal.

Q. Now, when was St. Louis & Belleville Railway Company organized? A. The St. Louis & Belleville Electric Railway Company was organized in—well, I can't say exactly when it was organized, but I can state when it came into the control of this group.

Q. All right, state that if you will. A. The first connection which this group had with it occurred when it acquired the control in 1922. It had been a part of what was known as the local railway and suburban system there, and the control dates from 1922.

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Q. Now, what does the company do and where does it operate? A. The company owns and operates a freight line, a short line of 11 miles in length, single track, which runs from a point in East St. Louis, at which it connects with the Terminal Railroad Association, and other railways, including the Alton and Southern Railway, and the Southern Railway Company, from this point of connection to a point not far from Belleville, Illinois, a distance of 11 miles.

At the southeastern terminus, that is the point near Belleville, it connects with the Illinois Central Railroad, over 7352

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which moves practically all of the fuel consumed in the Union Electric plants. By "Union Electric plants," I mean those of the group.

The investment in the railroad property is about $1,300,-000, and it normally employs about 60 men.

Q. And what does its property consist of? A. In addition to the single track line described, it has the trolley and feeder equipment, and two heavy type electric locomotives, one an 80-ton and the other a 90-ton locomotive. This latter 7353
locomotive has just been recently acquired and reconditioned, and will handle 18 to 20—50 ton cars at a time.

It is a well operated little road, has fully automatic sub-stations for supplying the current which it purchases from the Union Electric Company of Illinois, and in addition to two such automatic sub-stations, one not far from either end, it has recently acquired a portable 3,000 kilowatt sub-station which is mounted on a railroad car and can be located as required.

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Q. Have you stated how many coal cars the company owns and operates? A. The company owns several hundred which it uses itself and which it also leases out to other companies. There are about 450 steel and composite cars. It doesn't use all of those at all times for itself, but when the demand for coal is heavy it uses a large part of them, and the

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rest of the time it leases them out and obtains some of its revenue that way by rental from other roads. As a matter
7355 of fact, the ownership of this group of cars is an additional insurance against the shortage of coal for the Union Electric group.

During the previous World War we, in company with other users of coal, had great difficulty in obtaining an adequate number of cars, and if such a condition again arises, these 450 cars would be adequate to handle our requirements.

Q. Now, you stated, Mr. Stokes, that the principal business of the company was the hauling of coal. What proportion of the coal hauled by the company is constituted of coal
7356 going into the Union Electric group? A. The records for the last five years indicate that about 88 per cent. of the 3,620,204 tons hauled, were delivered to plants of the Union Electric group.

The company, in addition to the revenue paid from the rental of these cars, gets most of its revenue from a rate division from the connecting lines from whom it receives coal shipments.

Q. State the range, if you will, of net income for the company during the period 1930 to 1939? A. The smallest

net income during that 10-year period was $19,000, and the highest $116,000, the average income for the 10 years being about $56,000 a year. At no time during the 10-year period,

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which included the depression, did the road operate at a loss.

Q. I don't believe you have indicated the net income of the Union Colliery Company. Will you give us that figure as of a recent date? A. Well, for the year 1939, the net income of the Union Colliery Company was $61,408. 7358

Q. Does Union Electric Company of Illinois conduct a gas business, and if so, for how long a period has it conducted such a business. A. The gas business conducted in the city of Alton is owned and operated by the Union Electric Company of Illinois. It is a small gas business and is not a major part, at all, of the Union Electric Company of Illinois' chief operations.

The gas business has been an associated business with the Union Electric group since 1922.

Q. Now, you are speaking specifically of that business operated by the Union Electric Company of Illinois, are you not? A. That is right, in and around Alton, Illinois. It at one time had been the Alton Gas & Electric Company, which was acquired by Union Electric Company of Missouri, and merged with the Union Electric Company of Illinois in 1937, and the business has been carried on since that time in the name of the Union Electric Company of Illinois. 7359

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Q. Now, very briefly will you describe the property owned and operated in gas service by Union Electric Company of

7360 Illinois? A. The business of the company in the gas distribution, that is the territory in which this business operates, is located in and around Alton, which has been previously discussed and located as a town line some 20 miles north of East St. Louis. The company buys its gas as a mixture of manufactured and natural gas, from the Illinois-Iowa Power Company, and its own manufacturing company is operated primarily as a stand-by in the event of failure of purchased gas.

7361 The gas purchased and distributed to the users of gas in and around Alton has a heat content of 565 B. t. u. The stand-by plant is a carbureted water-gas plant with a capacity in three storage holders of 299,000 cubic feet. The production capacity of the plant is 200,000 cubic feet a day.

The distribution system is rather simple and consists of 63 miles of main, 5,778 services, serving 5,020 customers as of December 31, 1939.

Fifty-four out of the 63 miles of main are cast iron low pressure, and 9 miles are high pressure main.

The sales of gas in 1939 amounted to 75,300 m. c. f. for
7362 domestic purposes, and 21,200 m. c. f. for commercial use.

There are no house heating or major industrial customers in Alton.

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Q. Is the gas business of the Union Electric Company of Illinois operated jointly with its electric business? A. It is. They are operated just in close parallel operation, the same personnel both as to managerial, commercial and in general, practically all functions. Meter readers serve both businesses and in every possible respect they are operated as

though they were one company insofar as possible. They are one company, but I mean as though they were one business.

Q. Are there advantages arising to Union Electric Company of Illinois out of the joint operation of the two businesses? A. There are. Economies from the joint operation are the result of common use of every feature which is in any way possible. We have the same executive, same managers, the same maintenance groups, and meter readers, and collection system, and employees and so forth.

Q. I want you to be a little more specific on that. Can 7364
you state the amount of executives' salaries apportioned to the gas business in 1939? A. Well, they only apportioned $1,583 of executive salaries in 1939, and that would in no way have provided adequate executive supervision had it been operated separately.

As another example, meter reading costs in Alton have been compared with those in East St. Louis, which is operated by the same company, and which has no joint gas service.

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The costs were 43.5 cents per customer in the Alton district, 7365
as compared with 52.9 cents per customer in the East St. Louis district, the difference being due to the use of common meter readers for both services.

Collection costs at Alton in 1939 were 38.3 cents per customer, compared to 44.7 cents in East St. Louis, which again shows the economy derived from joint billing and collection. There is also a factor that because of the small size of this property it would be unable to obtain expert personnel such as it is able to get from its associated companies, and it isn't only a matter of just the particular cost, but a small

company like that could not afford the type of personnel that is available now to it. It can call on the Union Electric group in the electrical division for any electrical engineering work it may require, also on the mechanical groups and so forth. In fact, it can get an expert in almost every branch of its work, and that particularly applies to the assistance which it can get from the St. Louis County Gas Company, which will be discussed later.

The joint operation, taken as a whole, in the company up
7367 there, affords very appreciable savings which have been estimated at $33,860 a year as the combined effect of such joint operation. That total is divided into the savings due to ex-

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ecutive and department heads, sales, accounts, treasury department, distribution, storeroom and garage, and general office facilities. That perhaps doesn't sound like a huge sum of money when considered in the light of some of the figures we have been discussing, but it must be recognized that this is a small gas company.

Q. Are there advantages to the customers of Union Elec-
7368 tric Company of Illinois arising out of the joint operation of the two businesses? A. Well, any division of expenses which represents a saving to one company also represents a saving to the other. The best way to state it is that the economies of joint operation represent a certain overall saving which is distributed between the two groups and it affects each.

Q. Does the joint operation result in simplicity in meter reading and billing as well? A. It does, it results in simplicity and economy in all those operations.

Q. In order to get an idea of the relative importance of the gas business, will you give us a comparison of the number of customers served, the gas sales and revenues, for the period 1930 to 1939? A. This gas business to which you refer is the gas business conducted by——

Q. (interposing) My question relates solely to the Union

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Electric Company of Illinois. A. In 1930, there were 5,301 customers and there has been a slight decline, and by 1939
there are 5,020. The business has decreased slightly in the 7370
last 10 years, both in number of customers and in sales. The gas sales in m. c. f. in 1930 were 117,149; in 1939, there was a decline to 96,571.

The revenue likewise declined from $180,037 in 1930 to $141,631 in 1939.

This business is a very small fraction of the business conducted by the Union Electric Company of Illinois, and as a matter of fact it is less than a half of one per cent., referring to revenues, of the consolidated revenue of the Union Electric group.

Q. Does Iowa Union Electric Company conduct a gas 7371
business, and if so, how long a period has it done so? A. The Iowa Union Electric Company now operates a gas business which was previously known as the—well, I have got to correct that, the Iowa Union Electric Company which had a predecessor company known as the Keokuk Electric Company, operated a gas business in and around Keokuk. The Union Electric Company of Missouri, on January 6, 1926, acquired the interests which included this gas business. The business is now operated by the Iowa Union Electric Com-

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pany, which is a direct subsidiary of the Union Electric Company of Missouri.

Q. State briefly what property the company owns and

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operates, devoted to the gas business? A. The gas distributed in the city of Keokuk and vicinity is manufactured in a water gas plant whose capacity is 1,500 m. c. f. daily. The gas itself has a heat content of about 540 B. t. u. per cubic foot. The plant consists of two carbureted water gas sets,
7373 with the usual equipment, and a holder of 150,000 cubic foot capacity.

The distribution system has 33 miles of main which served 2,439 customers, as of December 31, 1939. The system of mains is cast iron and operated at low pressure. In other words, the pressure used is that at which the gas is used by the ultimate consumer.

In 1939, there were 40,500 m. c. f. sold and used almost entirely for domestic consumption. There is no house heating business and a very small amount of commercial business.

7374 Q. Are the electric and gas properties of the Iowa Union Electric Company operated jointly? A. They are, and the discussion which applied to the operations of the Union Electric Company of Illinois previously, with respect to the Alton Gas property, also applied to the joint operation of this gas company in which every opportunity available is taken advantage of to produce a more economical operation as the result of operating the two properties jointly with the same personnel and employees and facilities.

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Q. Now, do you mean by that statement that the advantages and benefits accruing out of joint operation in the Union Electric Company of Illinois are similarly applicable to the joint operations in the Iowa Union Electric Company? A. The nature of the operations and the nature of the advantages—I don't mean to say that numerically they are.

Examples of the economics of such joint operations can be given for the gas business at Keokuk.

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For example, executives' salaries apportioned to the gas property in 1939 were only \$574. Obviously, it would not have been possible to have had adequate executives for that sum. The cost of reading meters in 1939 was 43.7 cents per customer, compared with 47.9 cents in Fort Madison, Iowa, which is the city immediately north of Keokuk, and which is operated by the same company, but does not have the joint benefits, only electric operations being conducted at Fort Madison.

52.9 cents per customer in East St. Louis, as compared with this 43.7 at Keokuk, which indicates similar benefits of 7377
joint operation.

Collection costs in 1939 were 30.3 cents per customer for the Keokuk location, compared with 44.7 cents per customer in East St. Louis, where only electric customers are handled.

Billing and accounting expenses for the gas property amounted to 47.7 cents per customer as compared with 60.4 cents for East St. Louis—again where only electric accounts were handled.

They only render one bill in Keokuk to cover both electric and gas service, put them both on the same bill, the same meter reader, and there is a joint, parallel operation wherever possible.

This gas property is also a small property compared to the system of the electric property with which it is associated,

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and again the matter of personnel is of interest. It would
7379 not be possible for them to have the same type of experienced and skilled supervision and employees to which they now have access on a part-time basis.

I can sum up the estimated savings of joint operation as being something over $10,000 per year as affecting the gas company. Again keeping in mind that it is a very small company, this represents a substantial amount.

Q. Are there benefits arising to customers out of the joint operation of the two businesses by the Iowa Union Electric Company? A. Yes, the customer has simpler service, he has to deal with only one group, and has contact with
7380 only one meter reader, and he can pay his electric bills and his gas bills at the same office, or if he sends them by check, only one check is required, and the same clerk will handle any requests, whether for electric or gas, or both, in the event the customer wants to move or get service at a new location; and in many ways it is convenient and beneficial to the customers.

Q. Now state, if you will, the trend in number of customers, gas sales and gas revenues, for the Iowa Union Electric Company during the period 1930 to 1939? A. This

small gas business has decreased somewhat in the last 10 years, both as to customers and sales.

In the year 1930, it had 2,813 gas customers, with sales

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of 60,533 m. c. f., and a gross revenue of $102,675.

By 1939, the number of customers had reduced slightly to 2,439, and the sales in m. c. f. to 40,466, with a reduction in revenue to $56,284.

This company had a revenue in 1939 of less than .2 per 7382
cent. of the consolidated revenue for the Union Electric Group.

Q. Now you are speaking of the relation of gas revenue of the Iowa Union Electric Company? A. That is right. I wanted to point out that it is a very inconsequential part of the major operation.

Q. When was Union Electric Land & Development Company organized, and for what purpose? A. The Union Electric Land & Development Company was incorporated in 1929 to hold the land which it had been necessary, or would be necessary, to acquire as a part of the Bagnell Dam and Lake 7383
of the Ozarks hydro project.

The portion of the land required for the project was to be conveyed to the Union Electric Company of Missouri, who owned the project, and the so-called excess land, that which had to be acquired but which could not be included in the power project, was placed in the Union Electric Land & Development Company, so that it could be sold as readily as possible.

If this had been placed in the properties of the Union Electric Company of Missouri, it would have gone under the

mortgages and it would have been difficult to make arrangements to sell it, and the intention is to sell this land and

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liquidate this company as fast as it is possible to do so.

They are in the act of selling the land. The depression has interfered materially with the rapid sale of that land, because just at the time when there was the greatest public interest, we ran into the worst part of the depression, and people didn't feel able to purchase land which they did not
7385 have to have. This is largely useful for summer resort purposes.

They originally had about 70,000 acres of excess land, and that has been reduced to approximately 52,000 acres as of the present date. The actual acreage at the end of the year 1939 was very close to 53,400; and 1,418 acres have been sold in the first 9 months of 1940. So that, roughly speaking, 20,000 acres have been disposed of.

The company made every effort to make the purchase of this land attractive so as to be able to dispose of it, and they
7386 rebuilt one of the existing buildings at the site for a hotel, which they call the Holiday House. They also built a small restaurant at the south end of the dam, known as the Casino, and they provided boats and other recreational facilities to attempt to build up the attractiveness of that lake region. The lake itself is really a very beautiful body of water, and there is considerable recreation activity out there in the summer period, even in the late fall.

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Q. Now state the total assets, if you will, of the Union Electric Land & Development Company as of a recent date?

A. The property and plant account of the Union Electric Land & Development Company as of September 30, 1940, was approximately $1,940,000.

Q. And is it correct to say that this is a liquidating proposition? A. It is. The intention is to liquidate this property as quickly as it can be done, without unnecessary loss or expense.

Q. Turning now to the St. Louis County Gas Company, will you state the date of its organization and when it became
part of the system? A. The St. Louis County Gas Company 7388
and its predecessor have been in the control of the present owner, the North American Company, since its organization in 1904.

In 1912, the present company was formed to take over the assets of the original company, and the entire capital stock of this company, as well as that or the original company, has always been wholly owned by the North American Company.

It has thus been an associated business with the North American group, I mean the Union Electric Group, for about
36 years; that is, it has been under the direct ownership of 7389
the North American Company for that length of time.

Q. Now in order to get an idea of its relative importance and size, will you state as of a recent date the amount of prop-

—3,130—

erty and plant account of the company? A. The company had, as of May 31, 1940, an investment of $9,093,054 in its property and plant account. Its total assets amounted to $9,944,909.

In the preceding 12 months, the operating revenues were $2,378,135.

7390 This company serves the major portion of St. Louis County and has 52,334 customers.

Q. Now state, if you will, the extent of the territory served by the St. Louis County Gas Company? A. The St. Louis County Gas Company serves approximately 62 square miles in St. Louis County, and in these 62 square miles there is located about 250,000 of the county's total population of, roughly, 273,000.

Included in this area served by the Gas Company are
7391 many good-sized cities. In particular, there are 6 towns there, some of which have been previously mentioned in connection with the electric business, but I would like to name them, because they are over 10,000 population, and are important to the St. Louis County Gas Company.

These are Clayton, Kirkwood, Maplewood, Richmond Heights, University City and Webster Groves.

The population varies in those towns from a minimum of about 12,000 to a maximum of over 32,000 inhabitants.

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7392 In addition to the incorporated cities, large unincorporated areas are served. Some of these unincorporated areas are rather densely populated. They have a district known as Wellston, just outside of the northeastern city limits of St. Louis, which is more heavily populated than some of the city area just outside the limits, but it does not happen to be incorporated.

Mr. Hamilton: Will the reporter please mark this map for identification as Respondents' Exhibit No. 60?

(The document referred to was marked Respondents' Exhibit No. 60 for identification.)

By Mr. Hamilton:

Q. State, if you will, Mr. Stokes, what this exhibit represents? A. This exhibit represents the territory served by the St. Louis County Gas Company, and shows the extent of their major distribution system, including high-pressure mains, 4-inch and larger. Small mains and small services 7394
are not indicated.

The single-hatched area indicates the territory served by the high-pressure system, and the double-hatched territory in and around the city limits of St. Louis, indicates that served by the low-pressure system.

The heavy dashed lines are the high-pressure mains of 6 inches and larger, and the heavy dotted lines are high-

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pressure mains between 4 and 6 inches in diameter, including all sizes from 4 inches to 6 inches.

Q. Has this map been prepared under your supervision 7395
and have the facts shown been taken from the records of the St. Louis County Gas Company? A. It has been so prepared, and the facts have been taken from the records.

Mr. Hamilton: I offer it in evidence as Respondents' Exhibit No. 60.

Mr. Odell: No objection.

The Examiner: All right, the map of the territory described is admitted in evidence as Respondents' Exhibit No. 60.

(Respondents' Exhibit No. 60 was received in evidence.)

By Mr. Hamilton:

Q. State, if you will, what the trend has been in the business conducted by St. Louis County Gas Company, over a period of years? A. The business of the St. Louis County Gas Company has been consistently increasing, and is at the present time increasing even more rapidly than the popula-
7397 tion.

Q. Than the population of what? A. Than the population of St. Louis County, I should have stated. The population of St. Louis County itself has been previously stated

—3,133—

to be growing very rapidly, and this Gas Company is exceeding even that rate of growth. I could illustrate this very briefly by a few statistics.

In the year 1910, there were 5,210 customers with 126 miles of main and an annual sales in m. c. f. of 95,000.

7398 By 1920, the customers had increased to 13,569, the miles of main had increased to 286, and the annual sales of gas to 293,000 m. c. f.

For the year 1930, the number of customers had again increased to 38,510, the miles of main to 510, and the annual sales to 1,236,000 m. c. f.

By the year 1940, as of May 31,—this is for the 12 months ended May 31, 1940,—the number of customers has now become 52,334, with 658 miles of main and an annual sales of gas of 2,744,000 m. c. f.

The maximum daily send-out for this same 12 months' period, the highest send-out during that period, is 23,711 m. c. f. That is the highest send-out for any one day.

That is a rather remarkable growth, and very consistent. The territory which is served by the gas company is largely residential, and the requirements are of that character, but there are included some commercial areas, and a few large industries, not many.

Space heating for residences is of major importance to
this company, and they have been very successful in their 7400

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efforts over several years to develop a high rate of house-heating by all of their customers. They do extensive advertising, and they have been very successful.

As of May 31, 1940, the division of customers and their use may be stated as:

Residential customers for ordinary domestic use only—45,138; those customers used 950,335 m. c. f.

Heating customers, including ordinary domestic usage—
5,272; and they used 1,595,501 m. c. f. 7401

Commercial customers numbered 1,918, and used 134,464 m. c. f.

There were 4 industrial customers who used 63,271 m. c. f., and 2 street-lighting customers who used 286 m. c. f.

Q. Now may I inquire whether the number of customers you have just given is in each case at May 31, 1940, and whether the amount of gas sold is for the 12 months' period ended May 31, 1940? A. That is correct, the total of that group totals 52,334, which is the figure given for the number

of customers as of May 31, 1940, and the gas sold represents the 12 months ending with that date.

Over 5,000 of the 5,272 customers who used gas for heating, used it for heating residences, so that over 50,000 of the 52,334 total customers are residential customers. The importance of the heating load is very evident, because the

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10 per cent. of the total customers which used heating, used 58 per cent. of all the gas sold.

7403 (Discussion off the record.)

The Examiner: We will recess until 2 o'clock.

(Whereupon, at 12:30 o'clock p. m., a recess was taken until 2 o'clock p.m., of the same day.)

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AFTERNOON SESSION.

(The hearing resumed at 2:00 o'clock p. m.)

Whereupon, STANLEY STOKES resumed the stand and testified further as follows:

Direct Examination by Mr. Hamilton (Continued):

Q. Will you describe briefly the physical properties
operated by St. Louis County Gas Company? A. The gas 7406
manufacturing plant of the St. Louis County Gas Company is located at Shrewsbury in St. Louis County, Missouri. It has a capacity of 16,000 m. c. f. per day and the gas has a heat content of 800 B. t. u. per cubic foot. This consists of water gas which has been enriched principally with natural gas purchased from the Mississippi River Fuel Corporation which they convey by pipe line from Monroe, Louisiana.

The plant in which the manufactured portion of the gas is made was originally built in 1911 and has been considerably enlarged as the load developed. Until 1932 the gas manu-
factured and distributed was carbureted water gas contain- 7407
ing 570 B. t. u. per cubic foot. Since 1932 the gas distributed has been, as stated, with a heat content of 800 B. t. u. per cubic foot, being a mixture of manufactured water gas and natural gas.

(Discussion off the record.)

A. (Continued) The gas generating equipment consists of

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five water gas sets. I shall not attempt to describe them in

detail. Each set has the customary auxiliaries, such as blowers, oil handling equipment, automatic and hydraulic controls.

They also have facilities for cleaning the manufactured gas, including purifying condensers and Cottrell precipitators as well as the oxide purifier.

Manufactured natural gases are stored in a holder, the capacity of which is 4,500,000 cubic feet. An additional holder which is under construction will be in service some-
7409 time during this month, sometime in November and will have a capacity of 5,000,000 cubic feet. Manufactured gas is withdrawn from the storage holders and pumped through the mixing plant with reciprocating compressors with pressures varying at 12 to 45 pounds, depending on the demand.

The compressor plant consists of seven single stage, dual acting, twin cylinder compressors having a total capacity of 1,414,000 cubic feet per hour at 40 pounds pressure. The compressors are driven with either steam engines or electric motors. The normal method of operation is largely by electric motor, having a total of 2,845 horsepower.

7410 As the compressed gas passes through the mixing plant it is mixed with the high pressure natural gas. Each gas is automatically proportioned by a means of Smoot regulators, so that the resulting mixture has a heating value of 800 B. t. u. per cubic foot regardless of the variations in the heating value of either the natural or the manufactured gas.

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The operation of the regulators is automatically supervised by a Thomas calorimeter.

After leaving the mixing plant, the gas is passed through a 50,000 cubic foot spherical tank to further insure uni-

formity of the mixture before it reaches the distribution mains. Just before passing into the distribution mains the gas is conditioned by fogging with oil and hydrating with steam to prevent deterioration of the inside of the mains and the meters. Also, sufficient odor to enable a detection of gas leaks is imparted to the gas just ahead of the mixing operation.

Steam for the operation of the gas works is generated in the boiler plant which has a rated capacity of 1,395 boiler horsepower in four boilers, two of which are fired with either 7412
natural gas or oil and two with coal.

This boiler plant is augmented by a total of 610 boiler horsepower from waste heat boilers, on the water gas sets. Power is obtained from the Union Electric Company of Missouri through a 750 k. v. a., 13,200 volt sub-station, that part being 25 cycles. Sixty-cycle power is obtained directly at 4,000 volts for a 700 horsepower compressor and through a small sub-station for miscellaneous uses.

The distribution system, itself, consists of 118 miles of cast iron low pressure mains and 540 miles of high pressure steel mains, 595 miles of services and 55,289 meters. The 7413

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distribution mains are divided into two parts, one being the low pressure grid of 118 miles of cast iron pipe which ranges in size from four inches to 20 inches, covering a strip of territory immediately outside the city of St. Louis and indicated on Exhibit 60 by the cross-hatched area.

The other part of the system consists of high pressure mains totaling 540 miles of steel and wrought iron pipe in sizes from an inch and a quarter to 12-inch, which surround, more or less, the low pressure area and which extend to the

more remote parts of the territory. On the exhibit the smaller pipe was not attempted to be shown; nothing here below four inches was indicated.

In the low pressure part of the system gas is carried at pressure suitable for direct delivery to the customer's appliances, normally five inches of water column. The pressure carried in the high pressure system varies from 12 or 15 pounds to as high as 45 pounds per square inch, depending on load requirements, and is reduced to five inches of water
7415 column by governors located on the customer's premises.

All of the gas sent out from the plant is pumped into the high pressure system and the low pressure grid is applied from it through district regulators located at 13 points throughout the grid.

At three outlying points on the high pressure system there are high pressure storage holders, each of 50,000 cubic foot

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actual volume. Those are large spherical balls. They are like a balloon when you see them from a distance.

7416 In the low pressure section services are mostly of inch and a quarter steel pipe with a total length of 157 miles, and in a high pressure area, they are usually three-quarter inch steel pipe with a total length of 438 miles.

As of May 31, 1940, the company had 55,289 meters installed of which 52,367 were active.

The general office building, which houses the St. Louis County division of the Union Electric Company of Missouri, as well as the gas company, is located at Webster Groves. It is a two-story structure containing 44,200 square feet of floor space of which 30,300 are used for office purposes, the

remainder being occupied by store room, meter stops and a garage.

By Mr. Hamilton:

Q. That building is the property of the St. Louis County Gas Company? A. That is right.

(Discussion off the record.)

The Witness: There are store room facilities at
three locations, garage facilities at four locations, sales
offices are maintained at five locations for the con- 7418
venience of the customers where they can have the
service turned on or off or pay bills or purchase mer-
chandise.

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By Mr. Hamilton:

Q. Now, is the demand imposed upon the gas system
uniform throughout the year or does it fluctuate? A. It
fluctuates widely because of the extent of the gas residential
house heating. Over half of the gas sold is for space heating
for residences and the demand for that, of course, is a
function of the temperature and is very heavy on cold winter 7419
days. In the past winter, the maximum daily sendout was
23,711,000 cubic feet compared with the 1939 summer mini-
mum daily send-out of 2,727,000 cubic feet. The average daily
send-out in 1939 was 6,867,000 cubic feet. Such wide fluctua-
tions on the system are handled by varying the pumping
pressures to suit the load conditions.

This advantage is derived from the adoption, years ago, of the high pressure system of distribution in which this company was one of the pioneers. If the conventional low

pressure system of relatively larger cast iron pipe were used throughout the territory, a large increased investment would be required to provide larger mains which would be needed for the most part only to carry the winter load on those very few cold days which occur each winter. That is, a high pressure system is much better adapted for house heating service where the variation in the load is a large percentage.

At the manufacturing plant these fluctuations are met by simply starting up or shutting down the water gas sets as re-

7421 —3,142—

quired. These sets can be started up on relatively short notice and can be shut down with moderate standby losses, so that the plant, as a whole, was designed to fit nicely the demands and requirements of gas house heating.

Q. You have indicated that natural gas is mixed with the manufactured product. Has provision been made in the system for operation in the event of failure of the natural gas supply? A. Yes, there is always a possibility, although rare, that the natural gas line may be disturbed or the supply of gas shut off. For such emergency the reserve of natural
7422 gas and manufactured gas is stored in holders to meet temporary shortages and there are other provisions. Also, there is a store of 410,000 gallons of gas oil which can be gassified in the gas-making machines to enrich the manufactured blue gas, which is the carbureted water gas, should the natural gas fail. By this means a portion of the natural gas in the mixture distributed can be readily reduced from about 75 per cent. to about 45 per cent., thus making the available storage of natural gas last longer. Even without any natural gas, the oil-enriched manufactured gas alone could be distributed in an extreme emergency.

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In addition to that, 160,000 gallons of butane are kept on hand at all times to be used as stand-by in the event of long interruption in the supply of natural gas. Butane is a gas which is a liquid at ordinary temperatures and at a pressure of around 30 or 40 pounds and you can keep it in cylinders. It evaporizes readily into a gas and this quantity

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has equivalent heat content of 16,890,000 cubic feet of natural gas.

By making certain changes in the production of the water 7424
gas and using butane as an enricher, a resultant mixture satisfactorily substitutes for a normal mixture which is distributed. Further supplies of butane can be quickly obtained by rail if required.

As an example, in the eight years of operation with natural gas there has been one pipe line failure due to a washout and it required 12 hours to repair. In the meantime, the natural gas remaining in the pipe line between the break and the plant, together with the local storage, sufficed to continue operations on a normal basis without using any 7425
of these other stand-by facilities.

Q. Has St. Louis County Gas Company kept abreast of developments in the gas transmission and distribution service? A. The St. Louis County Gas Company has not only kept abreast of developments, but I believe it is a correct statement that they have been in the forefront of developments and have even pioneered in the extensive use of the small diameter steel pipe. This carries gas at higher pressures right to the customer's premises and some of it was used when the company first started operations in 1904. The

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territory then was sparse and we had very few customers per mile of main, and even now there are only about 80 customers per mile of main so that the customer density is not

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very high.

The present low pressure grid serves 153 customers per mile and the high pressure 63 customers per mile of main, the lower cost, small size high pressure pipe results in a substantially lower investment per customer, where it is
7427 most needed to make gas available economically in the more sparsely settled areas.

There are many areas in St. Louis County where, if it had been necessary to extend the low pressure cast iron system, it would not have been economical to do so, and if the customer had obtained service it would have been at higher cost.

When the natural gas was made available to the St. Louis district, the gas company very promptly took advantage of it and began to use it. Savings resulted in both production and distribution costs and were passed along to the customer in reduced rates for all classes of service. The reduction in
7428 rates for gas house heating applications has brought that cost down to where it is within the economic reach of over 10 per cent. of the residence customers. That is a very high use of gas house heating.

The use of the water gas method of manufacturing was adopted in the construction of the original plant as well as in its extensive additions since that time, largely because of its recognized greater flexibility to meet rapidly changing conditions. Consequently, when it became necessary to provide an emergency stand-by against interruption of the

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natural gas supply, this plant has a very low operating cost and meets the stand-by requirements exceedingly well.

Coke oven plants or other types of plants are difficult to shut down and start up quickly and they must be kept in fairly continuous operation.

The water gas plant can use various fuels, too, such as gas, oil, butane and so forth.

Q. Will you characterize the service rendered the customers by the St. Louis County Gas Company? A. The St. Louis Gas Company is a very modern and efficient company 7430
and gives the customer a very high grade service in all respects. The personnel of the company are highly trained and it is a wide-awake, active, up-to-date company.

The effect of the gas house-heating has been to produce a large winter peak, whereas in the early days of the company's operation the peak used to occur in the summer when people were putting up fruit.

The high pressure system also makes it simple to maintain adequate and uniform pressures throughout the district. They have modern equipment for cleaning the gas and the care with which it is reduced eliminates almost entirely the 7431
naphthalene which sometimes has a tendency to stop up the pipes, but there is very little of that in this gas. The gas, itself, is also comparatively dry, free from water vapors. They have a tendency to freeze in extremely cold weather.

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That phase of this dry gas has been improved by the use of the natural gas. It is better than it used to be before they used the naphtha gas.

Q. Is the gas service supplied by the company confined to St. Louis County? A. It is.

7432 *Stanley Stokes—By Respondents—Direct*

Q. It does not reach into the City of St. Louis, proper? A. No, it does not.

Q. Will you indicate, very generally, the nature of the rates charged and, if you are able to do so, make any comparison of rates? A. The rates are, in general, low. The cost per thousand cubic feet used by the average customer for ordinary domestic purposes is lower than it would be in the city for the same class of service.

Q. Now what city are you referring to? A. The City of
7433 St. Louis. They would be about 20 per cent. less than they would for that same class of service in the city. Such a customer in St. Louis County uses 1880 cubic feet per month, which costs $2.18. In the city this same amount of gas would cost $2.63. The average rate received per thousand cubic feet sold for all purposes in 1939 was 28 per cent. greater in St. Louis than in St. Louis County.

Q. Now, you are making a comparison, are you, with the

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rates of St. Louis County Gas Company? A. I am comparing St. Louis County Gas Company when I say "in the
7434 county" with city rates.

The average rate per thousand cubic feet for residential gas, including house heating, for the year 1939 was $.8892, approximately 89 cents. The commercial rate was just slightly under $1. There is not a large or extensive commercial sale in St. Louis County. The industrial rate is 60 cents per thousand cubic feet. These rates apply to the 800 B. t. u. gas.

Q. Of St. Louis County Gas Company? A. Of St. Louis County Gas Company and the comparison was on a similar

gas in the city. The relations between the St. Louis County Gas Company and their customers have been very friendly and I think extremely interesting over the last many years. For example, in 1917 to '18, during the early period of the first World War, prices of all things entering into the manufacture of gas were increasing very rapidly.

The company applied for relief and was granted a 10 per cent. increase in rates by the Public Service Commission, Missouri Public Service Commission. Subsequently, a committee appointed by it was known as the League of Munici- 7436
palities, being a group of the cities in St. Louis County, representatives of the various municipal authorities and including representatives of the county court, examined at the request of the gas company the company's accounts in detail and agreed that a further increase was in order.

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Now, this was being done by the customers, themselves. The League then agreed to higher rates which the company proposed and filed with the Commission, whereupon the Commission authorized the increase. This League had been
very successful in its relations with the accounting interests 7437
of all kinds and was kept in operation and continued to cooperate with the officials of the St. Louis County Gas Company, with the result that for over 20 years such negotiations have been carried on and the League was presented with the facts, and as fast as possible the rates were again reduced by the same process until today they are 17½ per cent. less on an equivalent heat basis than they were before the first World War.

The League each year kept informed concerning the results of the company's operation, revenues and expenses and

interest in gas property through a committee of the League, appointed for that purpose.

Q. Are the sales of gas actively promoted by the company? A. Very actively. The company has an active sales force and they do extensive advertising, even doing billboard advertising at times when conditions are right to promote the sale of house heating gas most actively.

They sell gas for cooking, water heating and refrigeration, residence refrigeration, the gas refrigerator being a

7439 very reliable and successful device.

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In St. Louis County the water rates are rather high and the development of the air-cooled gas refrigerator was made to assist us in this phase of the promotion work. Primarily the company goes after the residential business because that is the main thing they have to deal with.

Q. Does it engage in the sale of gas appliances? A. It does. They push the sale of the appliances through their five appliance stores and also by special appliance salesmen engaged in field work. In 1939 there were 1,846 gas consuming

7440 appliances sold by the company. We have no record available as to how many such appliances may have been bought outside, but there must have been a good many. That 1,846 was divided into various different types of appliances. There were 710 ranges, 608 water heaters, 214 refrigerators, 123 space-heating devices, gas furnaces, and 47 miscellaneous domestic devices and 144 miscellaneous commercial and industrial devices.

Q. Now, state the capitalization of the company as of recent date. A. The capitalization of the company as of September 30, 1940, was $4,100,000.

Q. In what class of stock? A. That is in common stock.

Q. Now, go through the rest of the capitalization as of the same date. A. The first mortgage 5 per cent. bonds represented $1,500,000 and a surplus of $2,322,647, making a

—3,150—

total as of that date of $7,922,647.

Q. State, if you will, the provisions maintained for depreciation. A. The reserve for depreciation for the last 20 years has not been less than 12 per cent. of the depreciable property. At the present time it is higher than that. 7442

Q. What is the current rate? A. The current rate of depreciation is 17.4 per cent.

Q. Are you able to state the coverage of earnings with respect to bond interest? A. In 1939 earnings available for bond interest after provision for depreciation, amortization of debt discount and expense and miscellaneous deductions, was $527,438 or over seven times the interest requirements.

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Q. Has the company ever defaulted on the payment of interest on any of its obligations? A. No, it has not.

Q. It has no preferred stock outstanding? A. No, it has 7443
not.

Q. Is the property of St. Louis County Gas Company operated jointly with the electric property of the Union Electric Company of Missouri in St. Louis County? A. Yes, in every possible respect the operations are carried on jointly. The officers and department heads of the gas company hold the same or similar positions with the electric company; the president, the executive vice president, the two vice presidents, the secretary, the treasurer, the comptroller hold the same or similar positions with the electric company.

Certain department heads of the electric company, such as the general store keeper and superintendent of supply service serve in the same capacities for the gas company. In the St. Louis County organization the various department heads and their operating staffs, such as auditor, engineer, sales manager, superintendent of distribution and superintendent of transportation function for both companies. Their functions are conducted jointly on most all of the operations. A little thought will illustrate the fact that a large
7445 percentage of the total operations for the electric and gas companies are identical. I can mention a list of those.

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Q. You might illustrate the point, if you will. A Well, briefly, the applications for service, turning on and off service, meter reading, billing, credit approvals, adjustment of customer accounts, collections, sales activities, operation of branch stores, receiving customers' payments, trouble service, keeping records of connections, engineering estimates and plans for extensions, maintenance of engineering records, obtaining permits and rights of way, maintenance of
7446 automotive equipment, telephone facilities, stenographic service, mail service and many other items including purchasing, stores, accounting, real estate, handling of real estate, taxes; in other words, the two systems are operated just as though they were owned by one company. This type of joint operation saves a considerable sum of money each year as compared with what it would have cost had the gas company been operated independently from the electric company.

Q. Now, can you illustrate the savings that arise out of such joint operation and indicate their approximate extent? A. Well, to illustrate the nature of the work that provides such savings, the meter reader, when he goes from house to house to read the meter, reads the gas meter at the same time and eliminates duplicate meter readers.

In the case of a customer moving to a new address, he will make but one telephone call; one clerk has both gas and electric problems.

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The branch officers of stores are maintained at various places, and the customers can conduct all of the functions of both the gas and electric operations at the same time without additional effort, so in addition to the financial savings or economies which are made, it is really a matter of considerable convenience to the customers, themselves.

The estimated savings may be briefly stated as, sales department, due to joint operation of five sales offices, $58,000. These are estimated annual savings per year.

In the accounting department, at total of $43,500. These are due to some of the things I have mentioned, for example, 7449
the joint reading of meters was estimated to save $19,600, and so forth.

The treasury department, a saving of $9,600; the distribution department, a saving of $33,300; the engineering department, $20,700; store rooms and garages, which include a large number of items, $37,900; purchasing expense, $6,000; general office facilities due to the rental savings from joint occupancy and the savings from joint heating and combination janitor, telephone service, and so on, $21,000; the total of the items just mentioned is $230,000 a year.

Now, those estimates have been made up carefully from a number of small items and do not include any savings as a result of combined executive salaries and expenses which, undoubtedly, do exist and it is reasonable to assume that there were other minor savings that had not been listed, so that the annual saving should be and is something in excess

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of $230,000 per year.

There are many little things that mean a good deal to
7451 the customers. I have already mentioned the conveniences in paying their bills at one location and, incidentally, either electric or gas will receive the payment. They are both billed and then they exchange the money and straighten out the account later. The customers save a considerable amount of postage by that method. It is estimated that this may amount to as much as $7,500 per year for the customers.

These combined operations with resulting economies are what make possible, to a large extent, the low rates at which the gas is sold. There isn't anything particularly different about distributing gas than there is about distributing elec-
7452 tricity. You have to use the streets, they are both delivering a service instead of a commodity, and their methods of doing business are necessarily the same.

Whenever two such businesses are operated jointly, there is naturally a saving in the combining of their functions. Moreover when the operations of two properties are combined the increased volume of work permits the use of high-salaried and more experienced personnel and then dividing the expenses.

In apportioning these expenses between companies, there is no profit or overhead expense added, and in distributing

material from the store rooms, the usual store's charge, which is calculated at cost, is made to the gas company in exactly the same manner that is made by the electric company. There

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is no profit, in any sense of the word, added to the distribution of these joint expenses.

The chief beneficiary in the long run from such economies of joint operation is the public who gets the savings reflected in their rates and the quality of service.

Q. During your testimony you have given us a number of 7454
examples of joint operation among the various companies, including the St. Louis County Gas Company and Union Electric Company and its subsidiaries. I don't want you to repeat the instances of joint operations or inter-relationships which you have already given, but I do want you to illustrate now, if you will, other instances which occur to you with respect to all of the companies. A. Well, I shall attempt to make this comparison and the example of joint operation as briefly as I can and still go straight to the point.

Of the number of buildings throughout the system that
are used jointly, as a matter of interest, you have the Gen- 7455
eral Office Building of the Union Electric Company of Missouri at 12th and Locust Streets in St. Louis which houses the general business offices for Union Colliery Company, St. Louis and Belleville Railroad Company, St. Louis and Alton Railway Company and the steam-heating business in the city of St. Louis. All of the various building facilities such as water, light, heat, refrigeration and telephone are, likewise, used by all of these companies.

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The general office building of the St. Louis County Gas Company houses the headquarters of the St. Louis County Division of the Union Electric Company of Missouri and the outlying divisions of the same company, as well as the offices of the treasury, sales, distribution, engineering and accounting departments of the St. Louis County Division of the Union Electric Company of Missouri.

The building which adjoins the general office building of the St. Louis County Gas Company in Webster Groves houses
7457 the meter shops for both the St. Louis County Division of the Union Electric Company of Missouri and the St. Louis County Gas Company.

In a like manner the general store room at 19th and Gratoit Streets and the Page Avenue store room in St. Louis County, both belonging to the Union Electric Company of Missouri, are used by it and the St. Louis County Gas Company.

Also, the store room of the St. Louis County Gas Company at Shrewsbury is used by the Union Electric Company of Missouri. Four garages in St. Louis County are used by
7458 Union Electric Company of Missouri and the St. Louis County Gas Company jointly. These, by the way, are extensive buildings and facilities. They are not just small garages. They house a large group of transportation equipment and they are permanent and rather extensive modern buildings. The chief ones are the Page Avenue garage which belongs to the Union Electric Company, the Webster Groves garage

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that belongs to the gas company, the Moody Avenue garage of Webster Groves, which is rented, and the Shrewsbury garage which belongs to the gas company.

There are four branch offices in St. Louis County jointly operated by the Union Electric Company of Missouri and the St. Louis County Gas Company. Those are located in Wellston, University City, Maplewood and Luxemburg. In addition both companies, as previously stated, maintain their general business offices in the gas company's building at Webster Groves.

At Keokuk, Iowa, the common office, common garage and store room are used by both the Iowa Union Electric Company and the gas business at Keokuk, which is also conducted 7460
there.

At Alton, Illinois the Union Electric Company of Illinois there have their facilities in common with the gas company which they operate.

The Lakeside Light and Power Company at Lakeside, Missouri and the Union Electric Land and Development Company have common offices and store rooms at Lakeside and are under common management.

I have previously mentioned the economy of combination use of the Ashley Street Power House and steam-generating facilities which are used both for the steam service as well as 7461
for power developed. The transportation equipment of the Union Electric Company of Missouri also handles all the work of the steam department. The Union Electric Company of Missouri does delivery work and delivers appliances to cus-

tomers and handles material between store rooms and takes care of the requirements of these various divisions, including the St. Louis County Gas Company, in the same manner that it handles its own work.

The same facilities and equipment are used in salvaging
material removed from the properties of the various com-
panies as are used by Union Electric Company of Missouri,
that is, the same facilities which they use for their own sal-
vage operations are used for the other companies.

Union Electric of Illinois, St. Louis County Gas Com-
pany, Union Colliery Company, St. Louis and Belleville
Electric Railway Company, their passenger cars, trucks,
trailers, and so forth, are all used each for the other as well
7463 as for themselves. For example, when a fire occurred in a
cable duct in downtown St. Louis a year or so ago, all of
the air compressor equipment, a number of trucks and
passenger cars of the gas company were immediately sent to
St. Louis and were of considerable aid in restoring condi-
tions to normal.

In St. Louis County all billing machines, mailing
machines, addressing equipment and other office machinery,
furniture and equipment are used jointly by the Union Elec-
tric Company of Missouri and the St. Louis County Gas
Company. Likewise, at Alton, Illinois and Keokuk, Iowa
7464 joint use is made of the general office equipment and
similarly at Lakeside the Union Electric Land and De-
velopment Company and the Lakeside Light and Power

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Company make joint use of such equipment.

The Union Electric Company of Missouri maintains an
automobile mail delivery service which connects its main
office with the various branch offices, store rooms, sub-sta-
tions and so on. This same mail delivery service is extended
to the St. Louis County Gas Company and the Union Electric

Company of Illinois, which avoids a considerable amount of duplication and an unnecessary expense.

The Union Electric Company of Missouri maintains a photostat and printing equipment which is made available to all the subsidiary and associated companies, which allows them to get such service at lower cost than they would have if they had to provide it for themselves.

The Steam-heating Division and the St. Louis County Gas Company have frequent occasion to make excavations for working on the mains or installing new mains and the equip- 7466
ment of the underground crews of the Union Electric Company of Missouri is used for that as well.

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Q. I think you have already indicated that certain executive officers acted in common for the various companies. Will you be a little more specific in amplifying that comment? A. Dr. William McClellan, Mr. E. T. Gushee, and Mr. John A. Woodbridge, president, executive vice president, and vice president, respectively, of Union Electric Company of Missouri, hold the same position in the various subsidiaries and affiliated or associated companies, and direct the busi- 7467
ness of all of this group of companies.

The smaller companies in the group consequently benefit from having available the same executive direction as the main company, the Union Electric Company of Missouri.

There are other officers of the Union Electric Company of Missouri who hold similar position, or carry out similar functions for the other companies. I can mention a few of these.

Mr. F. J. Meistrell, secretary; Mr. John L. Ganz, treasurer; Mr. A. H. Schlettler, comptroller—serve in the same

7468 capacity for virtually all of the group of companies, that is they have that position in the Union Electric Company of Missouri, and they have that or an equivalent position in each of the other companies.

Centralization of the functions of these corporate officers provides a greater uniformity of methods and practices, and the smaller companies and businesses benefit therefrom.

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Q. Are accounting procedures in the various companies
7469 directed by the Union Electric Company of Missouri? A.
Yes, the Union Electric Company of Missouri has the major accounting personnel, and they direct the accounting policies for the other companies, and make special accounting studies necessary for obtaining adequate accounting control, and they assist in setting up accounting methods so as to have available information needed for the various regulatory authorities, which information is continually required.

They obtain uniformity by such centralization, and they do most of that work under the general direction of the general auditor of the Union Electric Company of Missouri.

7470 It is necessary to have available adequate records of the property of the various companies, and to keep the records up to date as to property additions and removals for not only the Union Electric Company of Missouri, but for all of the subsidiaries and related companies.

That work is all under the direction of the valuation auditor. That provides for uniform methods and gives the benefits to the smaller companies of a high grade personnel.

In the preparation of financial reports, reports to regulatory authorities, and the maintenance of the records of a

statistical nature, this work is done for all the companies under the direction of the fiscal and statistical auditor of Union Electric Company of Missouri. To provide adequate

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information for the management so as to maintain the proper control of the finances of the company, budgeting of construction expenditures, the accounts affecting income and the cash requirements of all the companies are handled by the budget auditor of the Union Electric Company of Missouri. 7472

General supervision of accounting procedures and methods for the various companies is centralized in the operating auditor of the Union Electric Company of Missouri.

Income tax and related tax matters of all subsidiaries and associated companies are handled by the tax supervisor of the Union Electric Company of Missouri.

Q. I think you have already mentioned, have you not, the centralized purchasing agency which acts for all of the companies? A. Yes, that has been described in some detail.

Q. And also the centralized stores procedure which similarly acts for all the companies? A. That has also been described. 7473

Q. Is the engineering personnel of the various companies available to each company in the group? A. It is, and I think that is of considerable importance because it would not be practicable for these smaller companies to maintain an extensive engineering organization with high class personnel which would be too expensive to maintain for such

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small companies, as many of these are.

The way the matter is actually handled is that the mechanical engineers in the electric business—for example in the Union Electric Company of Missouri, the men who are responsible for not only the mechanical construction, but the mechanical operation—those engineers, with their knowledge of steam production and utilization, are used by the steam heating business for its engineering problems, and in giving engineering advice to its customers; and the electrical engineers of the Union Electric Company of Missouri, en-
7475 gaged in the electric business, are in a position to give engineering advice to the electric railway, coal mining, steam heating and gas businesses.

For example, my department just recently completed the design and pursued to its completion the construction, of a 3,000 kilowatt portable railway sub-station.

We also made a number of layouts and studies for the safety operation of the underground electric haulage in the mine.

Within a year, or such matter, we specified and supervised the purchase of a motor generator set for the mine. At
7476 that time the mine had been given to understand that the thing they should put in was a mercury arc rectifier. A little engineering and economic study of the problem showed that that was not suitable for their purpose.

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So that I could make a long list of examples to show the use of the various engineering facilities in and by the different companies.

The St. Louis County Gas Company has to have high grade engineers who are skilled and experienced in the pro-

duction and distribution of gas, and the services of those men are available to the gas business at Alton and at Keokuk, the first being under the direction of the Union Electric Company of Illinois, and the second under the direction of the Iowa Union Electric Company.

We recently completed the design, including detailed
drawings for a sub-station of the Iowa Union Electric Com-
pany at Ft. Madison, where they were putting in frequency
changers and completely changing the distribution system to
convert the town from 25 cycles to 60 cycle service. 7478

Q. When you say "we" who do you mean? A. My own immediate department.

Q. In the Union Electric Company of Missouri? A. Which functions for the Union Electric Company of Missouri.

In such operations we keep an accurate check of the
hours worked on that project, and all the men that report
to me distribute their time exactly as worked. My time is
not distributed in exactly that manner, but on a fixed and
equitable basis, adjusted each year based on the amount of 7479

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business done for the different companies. No profits of any kind, or overheads, are added.

Q. Are property tax matters for various companies centralized in one department? A. Yes, the property tax matter has been previously mentioned, but I could explain that the returns of property for taxation, appearances before tax authorities, studies of tax equalization, and related tax matters for all of the companies, are centralized in a real estate

and tax department of the Union Electric Company of Missouri.

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Q. Are real estate transactions similarly centralized in one department? A. They are, the real estate department of the Union Electric Company of Missouri.

They advise and take care of the real estate problems for the other companies.

7481 We just recently had quite a little series of problems at the new Venice plant site where certain easements ran through the site, and were set apart for the levee board, giving them a right to maintain levees in certain locations; in addition to which, there were some early street easements, and a further complication by reason of the fact that at one time boats used to land at a regular landing at that point, and the people going to and from the boats had crossed the property for some years. It was necessary to clear up all of these matters before the plant building could be located and work started.

7482 The real estate department was of particular help to the Union Electric Company of Illinois in that work.

Q. Does the research department of the Union Electric Company of Missouri perform services for, and is it available to, the other various companies? A. It does. The research department of the Union Electric Company of Missouri is essentially an economic research department. I mean economic as distinguished from a research department which would be working with laboratory equipment.

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They make business studies and investigate personnel problems, analyze any means of improving economies or bettering the operating method.

That department is available to all companies, and functions primarily for the larger company, the Union Electric Company of Missouri, but is called in for various types of studies, and charges, of course, only the cost of the work.

Q. How about the Director of Industrial Relations of Union Electric Company of Missouri? A. We have mentioned him previously several times in a little different con- 7484
nection, but he functions for all of the different groups of companies and maintains an employment office in the general office building at St. Louis, and carries on employment activities for the Union Electric Company of Missouri, the Union Electric Company of Illinois, and the St. Louis County Gas Company.

He does not maintain employment offices at the other places because they are very small, but he carries on the operation.

The centralization of these various functions performed 7485
by the Director of Industrial Relations naturally results in a more accurate compliance with employment laws, a greater uniformity of personnel policies, and a lower cost of performing these various functions—all of which primarily benefit the smaller companies in the group.

Q. Is there a chief hydraulic engineer for the Union Electric Company of Missouri, and if so, does he perform

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services for any of the other companies? A. Yes, Mr. Davis has previously been mentioned. He is the chief hydraulic

engineer. He was mentioned in other connections such as the development he made on governors and so on.

He does function for the Mississippi River Power Company and for the Union Electric Company of Missouri, handling the hydraulic operation for both the Bagnall Dam and the Keokuk power plant.

Without that joint operation it would be necessary to have two men of a caliber equal to that of Mr. Davis, because either operation requires the same skill, experience and
7487 ability. With that one man handling the whole hydraulic work for both companies, he is in better touch with the situation at all times.

Mr. Hamilton: I believe that is all at this time, Mr. Examiner, from this witness.

If I understand correctly the cross-examination of Mr. Stokes is scheduled for tomorrow.

(Off the record discussion.)

Mr. Odell: Mr. Examiner, I would like to have this hearing continued until two o'clock tomorrow after-
7488 noon, at which time I hope to be prepared to cross-examine Mr. Stokes.

The Examiner: All right, we will continue the matter until two o'clock tomorrow.

(Whereupon, at 3.20 p.m. the hearing was recessed until 2 p.m. of the following day, Thursday, October 31, 1940.)

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BEFORE THE 7489

Securities and Exchange Commission

Docket No. 59-10

IN THE MATTER

of

THE NORTH AMERICAN COMPANY, *et al.* 7490

Hearing Room 1102-A,
Securities and Exchange Commission Bldg.,
Washington, D. C.,
Thursday, October 31, 1940.

Met, pursuant to adjournment, at 2 o'clock p.m. 7491

Before: W. W. SWIFT, *Trial Examiner.*

Appearances:

S. PEARCE BROWNING, JR., and CHARLES S. HAMILTON, JR., of Sullivan & Cromwell, 48 Wall Street, New York City, Attorneys for the Respondents.

RALPH C. BINFORD and HERMAN ODELL, Attorneys for the Securities and Exchange Commission.

PROCEEDINGS

The Examiner: The hearing will come to order.

Mr. Odell: Mr. Examiner, at this time I am not prepared to cross-examine Mr. Stokes.

I find that in view of his lengthy testimony, and the technical nature of the testimony, that I need more time to prepare my cross-examination.

I therefore will not be prepared to cross-examine him this
7493 afternoon, and will not be prepared to cross-examine him tomorrow morning. I will be prepared to cross-examine him any time after Saturday of this week.

Mr. Browning: We are both surprised and disappointed with the statement by Commission counsel in view of the previous discussion and the clear understanding that cross-examination of Mr. Stokes would take place today.

We are really inconvenienced, and I will not insist upon our strict rights only because I am unwilling to put the Commission's staff in a position which they insist will be disadvantageous to them.

7494 I must say for the record, however, that in view of the position which we are taking today, that we will hereafter expect a similar attitude on their part.

Under the circumstances, it would seem that the only practical step to take would be to adjourn until Thursday, November 7, at which time we will be prepared to put another St. Louis witness on the stand.

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It is my understanding that Commission counsel will endeavor at that time to give us their views as to whether

they will desire to cross-examine Mr. Stokes, so that if so, he can then be recalled for the next session.

The Examiner: Very well, this matter is now continued until Thursday, November 7, at 10 a.m.

Mr. Odell: I want to add this. I don't think it is unreasonable to ask to have two or three days to prepare to cross-examine a witness like Mr. Stokes, whose testimony was quite voluminous and quite technical in nature.

I think that we have always cooperated with Mr. Brown- 7496
ing in all of his requests for continuances, and we have always acceded to his requests for additional time to prepare his next witness for direct examination.

Mr. Browning: In that connection, Mr. Examiner, our only objection whatever to the delay has been because of the necessity of Mr. Stokes returning to St. Louis for his own business reasons. We would be only too glad to give any amount of time for cross-examination of any witness, if the business aspects permitted.

Mr. Odell: I fully appreciate Mr. Stokes' position here,
and I don't want to inconvenience him in any way. I have 7497
tried as hard as I could to accommodate Mr. Browning and Mr. Stokes, and have attempted to be prepared to cross-

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examine him this afternoon, but I find that that is impossible.

The Examiner: All right, we will continue the hearing until the time I have indicated.

(Whereupon, at 2:05 o'clock p.m., the hearing was continued until 10 o'clock a.m., Thursday, November 7, 1940.)

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